DINAMAP®

PRO SERIES 100-400
SERVICE MANUAL

CRITIKON
VITAL ANSWERS™

DINAMAP® PRO Monitor

Models 100, 200, 300, and 400

Service Manual

CRITIKON

VITAL ANSWERS™

List of Effective Pages

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U.S. Patent 4,360,029
U.S. Patent 4,501,280
U.S. Patent 4,546,775
U.S. Patent 5,518,000
Patents Pending

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(Items colored red are section leaders, click on brown to return to this screen)

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SECTION 1. INTRODUCTION

1.1. SCOPE OF MANUAL

This Service Manual provides service, parts, repair information and functional descriptions for the DINAMAP® PRO Monitors, models 100, 200, 300, and 400. The model number identifies the vital signs monitoring capabilities built into the unit.

- PRO 100: BP, pulse
- PRO 200: BP, pulse, temperature
- PRO 300: BP, pulse, SpO_2
- PRO 400: BP, pulse, temperature, SpO_2

This manual is intended for use by biomedical engineers and trained service technicians who are familiar with electromechanical devices and digital and analog circuit techniques.

WARNING

To reduce the risk of electric shock, do not open the case. No user-serviceable parts are inside the case. Refer servicing to qualified service personnel.

Trained service technicians should perform all unit repairs.

Voltages dangerous to life exist in this unit. Take care when servicing power supply and display assembly.

For information about operating PRO Monitors in a clinical environment, refer to the separate *Operation Manual*.

This *Service Manual is* composed of the following five sections:

- **Section 1** describes this volume and tells you how to use it. Information is also provided about how to get assistance in the event the unit fails to function properly.

- **Section 2** provides the physical and functional characteristics of the PRO Monitor.
- **Section 3** explains the principles of operation for the PRO Monitor, including an overall system description and principles of operation at the PWA (printed wiring board) level.
- **Section 4** provides information about periodic and corrective maintenance of the PRO Monitor. Procedures include calibration checks, recalibration, performance tests, and fault isolation.
- **Section 5** provides component information about the PRO Monitor, including disassembly procedures, parts lists, assembly diagrams, and electrical schematics.

1.2. ADDENDA

When this manual was published it included the most up-to-date information and procedures available. However, the specifications, design, assembly or software controls may change. These changes are incorporated into this manual by addenda.

1.3. TRADEMARKS AND TRADE NAMES

This document references terms which are proprietary, and may be registered and protected by copyrights and other applicable laws and agreements.

The first time trademarks and trade names are used in a section of this document, they are followed by "™" or "®". A footnote will identify the owner of the trademark or trade name.

1.4. SERVICE POLICY

The warranty for this product is enclosed with the product in the shipper carton. All repairs on products under warranty must be performed or approved by Product Service personnel. *Unauthorized repairs will void the warranty.* Products not covered by warranty should be repaired by qualified electronics service personnel.

1.5. EXTENDED WARRANTIES

Extended warranties may be purchased on most products. Contact your Sales Representative for details and pricing.

1.6. ASSISTANCE

If the product fails to function properly, or if assistance, service or spare parts are required, contact Customer Support. Before contacting Customer Support, it is helpful to attempt to duplicate the problem and to check all accessories to ensure that they are not the cause of the problem. If you are unable to resolve the problem after checking these items, contact Customer Support. When you call, please be prepared to provide:

- Product name and model number
- A complete description of the problem

If repair parts or service are necessary, you will also be asked to provide:

- The product serial number
- The facility's complete name and address
- A purchase order number if the product is to be sent for repairs or you order spare parts
- The facility's Critikon account number, if possible
- The part number for replacement assemblies or parts.

1.7. SERVICE

If your product requires repair service, call Customer Support and a representative will assist you.

Prior to returning any product for repair, you must request a Return Authorization number.

Call Critikon at: **1-877-274-8456**

Monday through Friday, 8:00 a.m. to 7:00 p.m. EST, excluding holidays.

1.7.1. Packing Instructions

Follow these recommended packing instructions.

- Remove the battery, and all hoses, cables, sensors, and power cords from the PRO Monitor before packing.
- Pack only the accessories you are requested to return. Place them in a separate bag and insert the bag and the product inside the shipping carton.
- Use the original shipping carton and packing materials, if available.
- If the original shipping carton is not available, place the product in a plastic bag and tie or tape the bag to prevent loose particles or materials from entering openings such as the hose ports.
- Use a sturdy corrugated container to ship the product; tape securely to seal the container for shipping.
- Pack with 4 in. to 6 in. of padding on all sides of the product.

1.7.2. Insurance

Insurance is at the customer's discretion. Claims for damage to the product must be directed to the shipper.

1.7.3. Service Loaners

A loaner unit is provided at no charge during the service life of the product when the repair service is performed by Critikon. Within 48 hours of your request, a loaner will be shipped to your facility.

- Critikon will pay shipping charges for a loaner sent to the customer for product repairs under the warranty.
- Shipping charges for a loaner sent to the customer for product repairs not under warranty will be billed to the customer.
- Shipping charges for the return of a loaner to Critikon will be paid by the customer.

All loaners provided to customers must be returned within the specified time stated on the loaner agreement or a rental fee will be incurred.

1.7.4. Replacement Assemblies and Components

Assemblies and components can be ordered from Critikon:

Via phone: 1-877-274-8456

Via FAX: 1-813-887-2430

Information is also available on the World Wide Web at:

http://www.critikon.com/

All orders must include the following information:

- Facility's complete name, address, and phone number
- FAX number
- Your purchase order number
- Your Critikon account number

Please allow one working day for confirmation of your order.

1.7.5. Replacement Accessories

Replacements such as hoses, sensors, etc. must be purchased from Critikon at 1-877-274-8456. Please have the Reorder/Product Code or part number of the item you wish to order, your purchase order and account number available.

1.8. INSTALLATION AND OPERATION

For information on the installation and operation of the PRO Monitor, refer to the separate *Operation Manual*. The PRO Monitor should be operated and serviced by authorized personnel, and only in accordance with the warnings and precautions given in both the *Operation Manual* and this document.

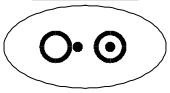
1.9. WARNINGS AND PRECAUTIONS

Refer to the operating safety warnings and precautions detailed in the separate *Operation Manual*.

1.10. SYMBOL DEFINITIONS

The following symbols are used with the PRO Monitor

Attention: consult accompanying documents



Power Off/On

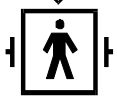
Silence Alarms

START/STOP BP

AUTO BP

Mean Arterial Pressure

External Communications Port Connector



Defibrillator-proof Type B.F. equipment

SpO_2

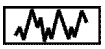
Temperature Value

Battery Power

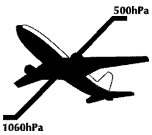
Beats Per Minute

External AC or DC power

SpO_2 Motion Artifact (US)



SpO_2 Motion Artifact (Europe)



Packaging label depicting the transportation and storage atmospheric pressure range of 500 to 1060 hPa

IPX1	The DINAMP PRO Monitor is protected against vertically falling drops of water and conforms with the IEC 529 standard at level of IPX1. No harmful effects will come of vertically falling drops of water making contact with the Monitor

1.11. GLOSSARY OF TERMS AND ABBREVIATIONS

AC	Alternating Current
ADC	Analog to Digital Converter
ADU	Analog to Digital Units: The Main board ADC has 65,536 steps which equates to 5V full scale (76 microV/ADU) Secondary Processor ADC has 256 steps which equates to 5V full scale (19.531mV/ADU)
AM	Amplitude Modulation
ASSY	Assembly
BP	Blood Pressure
BPM	Beats Per Minute
DC	Direct Current
DMM	Digital Multi-Meter
FET	Field Effect Transistor
FPT	Filtered Pressure Transducer
GAL	Gate Array Logic
mb	Millibar
mmHg	Millimeters Mercury
HCD	Host Communications Device
Hz	Hertz
ITU	Intensive Therapy Unit
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MAP	Mean Arterial Pressure
NIBP	Non Invasive Blood Pressure
NiMh	Nickel Metal Hydride
OSC	Oscillatory
PSU	Power Supply Unit
PWA	Printed Wiring Assembly
SPI	Serial Peripheral Interface
TTL	Transistor to Transistor Logic
UUT	Unit Under Test
VAC	Volts Alternating Current
VDC	Volts Direct Current
VFC	Voltage to Frequency Converter

SECTION 2. PRODUCT DESCRIPTION

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SECTION 2. PRODUCT DESCRIPTION

2.1. INTRODUCTION

DINAMAP® PRO Monitors provide non-invasive determination of systolic blood pressure, diastolic blood pressure, mean arterial pressure, pulse rate, temperature, and oxygen saturation. These portable AC and DC operated monitors are primarily intended for use in hospital acute care settings such as outpatient surgery, accident and emergency, labor and delivery, GI/endoscopy, and medical/surgical units.

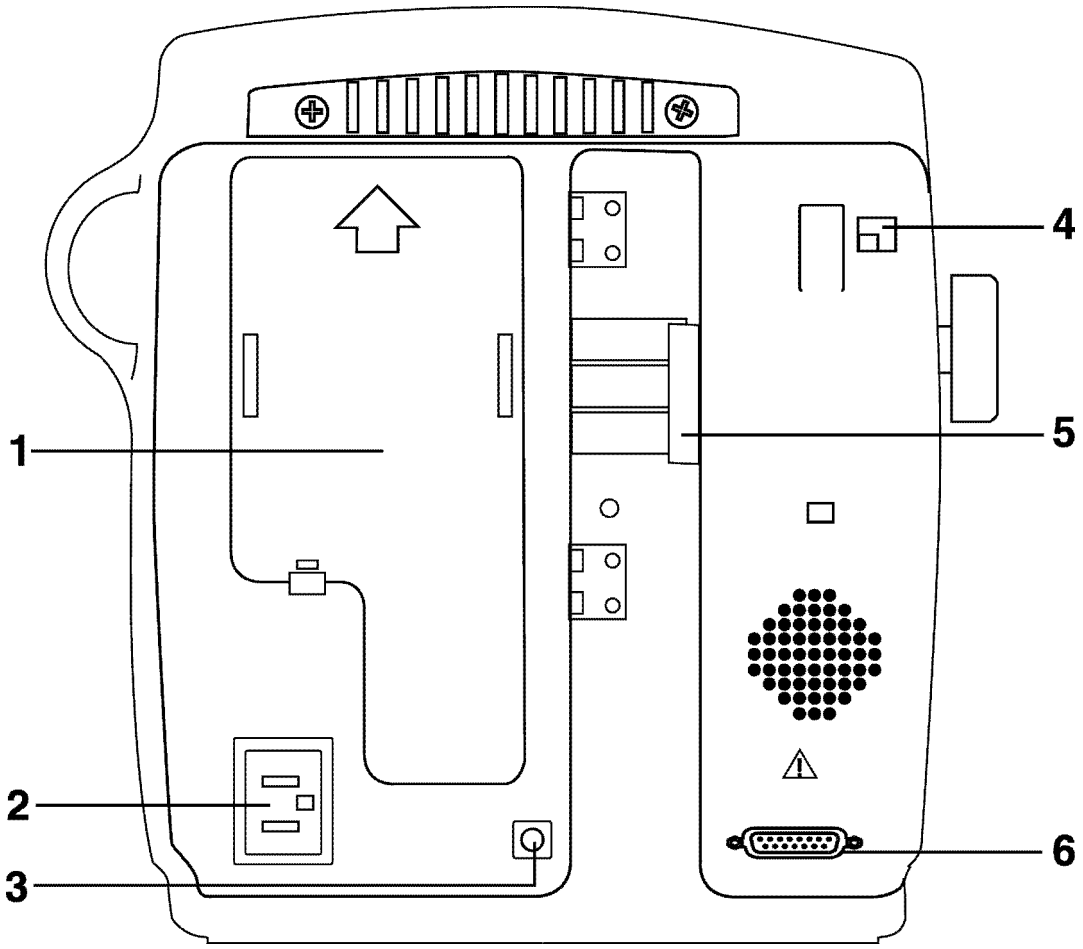
2.2. PRODUCT CONFIGURATIONS

Each PRO Monitor is supplied with an accessory pack. The contents of the pack vary according to model. Unpack the items carefully, and check them against the contents checklist enclosed in one of the accessory boxes. If there is a problem or shortage, contact Critikon.

It is recommended that all the packaging be retained, in case the PRO Monitor must be returned for service in the future.

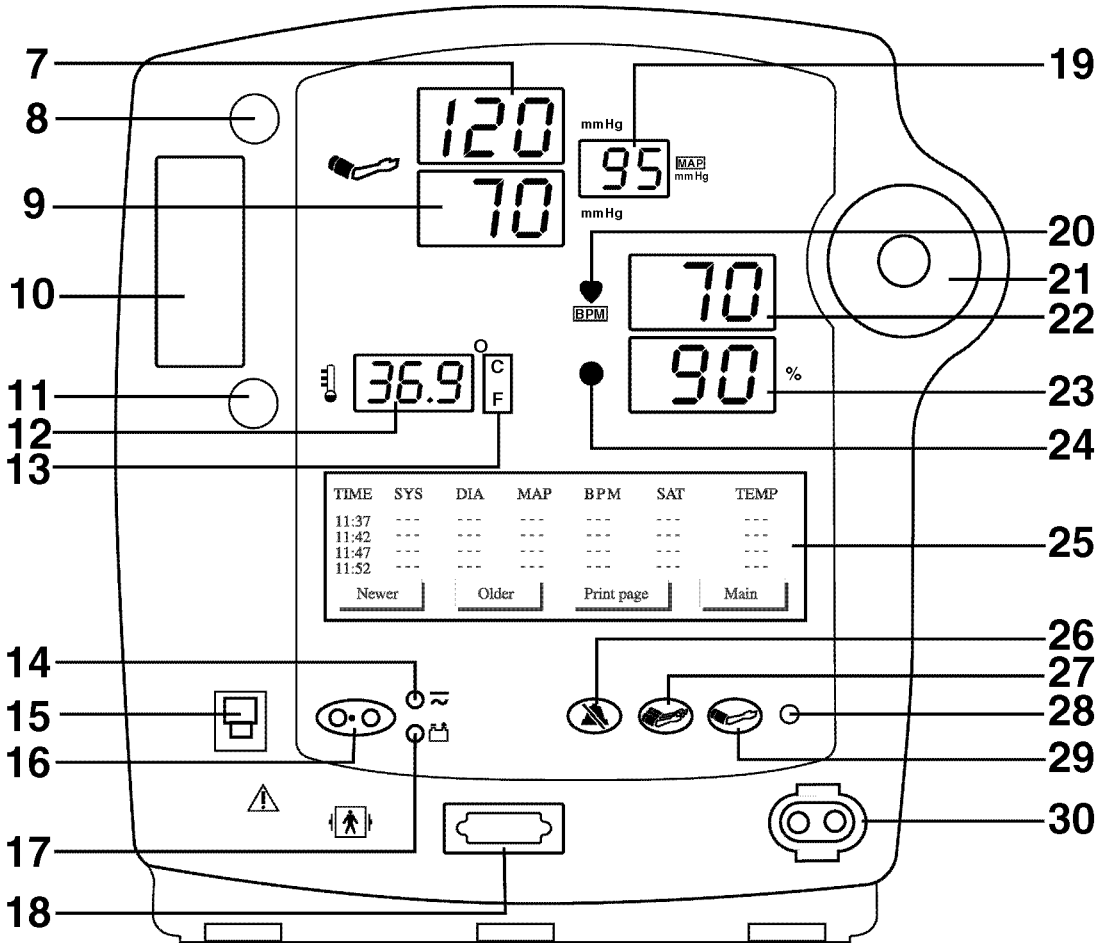
2.3. CONTROLS, INDICATORS, AND CONNECTORS

Descriptions of the items shown are listed on the pages that follow. For symbol definitions, refer to Section 1 of this manual.



2.3.1. PRO Monitor Rear Panel Connections

1. Battery compartment cover: Retains and protects the internal battery
2. Mains input: Used to connect to AC power supply
3. External power socket: To be used with approved AC-DC power converter ONLY
4. Inactive temperature cable storage: Inactive temperature probe cable attaches here (Models 200 and 400)
5. Pole clamp: Used to clamp monitor to pole or stand
6. Data interface connector: Host communications port (15 way D-type RS-232 serial port) for use only with equipment conforming to IEC 601-1. Refer to section 2.4 for connection details.



2.3.2. Front Panel Controls and Indicators

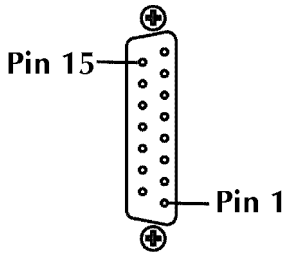
7. Systolic pressure display: 3-digit red LED indicates measured systolic BP in mmHg
8. Active temperature probe holster: Temperature probe that is being used stored here (Models 200 and 400)
9. Diastolic pressure display: 3-digit red LED indicates measured diastolic BP in mmHg
10. Temperature probe cover storage: Box of probe covers stored here (Models 200 and 400)
11. Inactive temperature probe holster: Extra temperature probe stored here (Models 200 and 400)
12. Temperature display: 4-digit red LED indicates measured temperature (Models 200 and 400)

13. °C °F display: Indicates whether temperature is being displayed in degrees Celsius or Fahrenheit (Models 200 and 400)
14. External power indicator: Green LED indicates external power status and battery charging status of PRO Monitor
15. Temperature probe connector: Temperature probe cable attaches here (Models 200 and 400)
16. ON/OFF switch: Controls on/off state of PRO Monitor; push for power on and push again for power off
17. Battery power indicator: Yellow LED indicates operation and charge status of battery
18. SpO_2 sensor connector: SpO_2 sensor extension cable attaches here (Models 300 and 400)
19. Mean arterial pressure display: 3-digit red LED indicates measured MAP in mmHg and shows instantaneous cuff pressure during BP determination
20. SpO_2 pulse indicator: Yellow LED in heart symbol flashes to indicate that real-time pulse rate measurements are being derived from SpO_2 signals (Models 300 and 400)
21. Rotor: Used to highlight and select items in LCD menus; if monitor is off, pressing rotor will switch monitor on
22. Pulse BPM display: 3-digit yellow LED shows pulse rate in beats per minute
23. SpO_2 display: 3-digit red LED indicates oxygen saturation in % (Models 300 and 400)
24. SpO_2 artifact indicator LED: illuminates when motion artifact is detected (Models 300 and 400)
25. LCD (liquid crystal display): Displays all alarms, user interface messages, and configuration options
26. Alarm silence switch: Alternately mutes and enables audible alarms; when pushed once after alarm sounds (silence on), the switch illuminates to indicate that audible alarms have been silenced for 2 minutes

27. AUTO BP key: Press to start Auto BP mode
28. Light sensor: Automatically measures ambient light to set LED display intensity
29. START/STOP BP key: Press to start or stop a BP, Auto, Stat, or Vitals determination
30. Cuff connector: BP cuff hose attaches here

Not Shown: The printer access door is located on the left side of the monitor. Push the latch to open the door and access the paper supply and print head. For details, see Section 5, Component Information.

2.4. HOST PORT CONNECTOR (REAR PANEL)



Important! All host port signals are NON-ISOLATED and should be connected to equipment conforming to IEC 601-1 ONLY. Where isolation of data communication is required, the Critikon isolated level converter should be used. If external alarm control is required, Critikon part number 487208 (Isolated Remote Alarm Cable Assembly) should ALWAYS be used. Please refer to the Information Sheet included with the isolated remote alarm cable for operational details.

Note: When using remote alarm, the PRO Monitor should be considered the primary alarm source. The secondary alarm is used for secondary purposes only.

2.4.1. Pin Assignments

Pin	Function
1	Ground
2	Inverted TTL Transmit Data
3	Inverted TTL Receive Data
4	Fused +5 volts
5	No connection
6	No connection
7	Ground
8	Remote Alarm
9	RS232 Request to Send (RTS)
10	RS232 Clear to Send (CTS)
11	RS232 Transmit Data (TxD)
12	No connection
13	RS232 Receive Data (RxD)
14	No connection
15	No connection

2.5. COMPATIBLE PARTS

The following parts are available from Customer Service.

Description of Compatible Part	Code
SOFT-CUF™ ,Cuff, Infant	2500
SOFT-CUF™, Cuff, Child	2501
SOFT-CUF™, Cuff, Small Adult	2502
SOFT-CUF™, Cuff, Adult	2503
SOFT-CUF™, Cuff, Large Adult	2504
SOFT-CUF™, Cuff, Thigh	2505
SOFT-CUF™, Cuff, Neonatal type 1	2521
SOFT-CUF™, Cuff, Neonatal type 2	2422
SOFT-CUF™, Cuff, Neonatal type 3	2523
SOFT-CUF™, Cuff, Neonatal type 4	2524
SOFT-CUF™, Cuff, Neonatal type 5	2525
DURA-CUF® Cuff, Infant	2783
DURA-CUF® Cuff, Child	2781
DURA-CUF® Cuff, Small Adult	2779
DURA-CUF® Cuff, Adult	2774
DURA-CUF® Cuff, Large Adult	2791
DURA-CUF® Cuff, Thigh	2796
DURA-CUF® Cuff, Assortment cuff pack	2699
DURA-CUF® Cuff, Child pack	2697
CLASSIC-CUF™ , Cuff, Infant	2618
CLASSIC-CUF™, Cuff, Child	2613
CLASSIC-CUF™, Cuff, Small Adult	2608
CLASSIC-CUF™, Cuff, Adult	2603
CLASSIC-CUF™, Cuff, Large Adult	2643
CLASSIC-CUF™, Cuff, Thigh	2648
CLASSIC-CUF™, Cuff, Neonatal type 1	2638
CLASSIC-CUF™, Cuff, Neonatal type 2	2633
CLASSIC-CUF™, Cuff, Neonatal type 3	2628
CLASSIC-CUF™, Cuff, Neonatal type 4	2623
CLASSIC-CUF™, Cuff, Neonatal type 5	2619
12 Foot (approx. 3.7 meters) Long Adult / Pediatric Hose	107365
24 Foot (approx. 7.3 meters) Long Adult / Pediatric Hose	107366
12 Foot (approx. 3.7 meters) Long Neonatal Hose	107368
12 Foot (approx. 3.7 meters) Long A/P Hose Quick Disconn.	107368
IVAC** Oral Temperature Probe	088012
IVAC** Rectal Temperature Probe	088013
IVAC** Temperature Probe Covers	088015
DINAMAP® PRO Monitor Operation Manual	776995*
DINAMAP® PRO Monitor Service Manual	777105*
12 Volt Lead Acid Battery	633132
Accessory Pole/Basket/Base	3215
Power Converter	621262*
Printer Paper (Box of 10)	089100
Power Cable	316579
NELLCOR*** SpO_2 Extension Cable	SCO10*
NELLCOR Finger Sensor	DS100A
NIBP Calibration Kit	320246

* PRO Monitor unique parts

** IVAC is a trademark of ALARIS Medical Systems

*** NELLCOR is a trademark of Mallinckrodt, Inc.

2.6. SPECIFICATIONS

CE 0086	This product conforms with the essential requirements of the Medical Device Directive. Accessories without the CE Mark are not guaranteed to meet the Essential requirements of the Medical Device Directive.
IPX1	The PRO Monitor is protected against vertically falling drops of water and conforms with the IEC 529 standard at level of IPX1. No harmful effects will come of vertically falling drops of water making contact with the monitor.

2.6.1. Power Requirements

MAINS **AC INPUT VOLTAGE**	Protection against electrical shock - Class 1 115 / 230 VAC, 50 / 60 Hz (nominal), 90 ~ 253 VAC, 47 ~ 63 Hz (range)
ALTERNATE SOURCES **DC INPUT VOLTAGE** **EXTERNAL DC INPUT FUSE** **BATTERY**	Protection against electrical shock – Class 1 24 VDC (nominal), 12-30 VDC from supplied power converter Internal, auto-resetting. 12 volt, 2.3 amp-hours. Protected by auto-resetting fuse. Minimum operation time: 2 hours (5 minute auto cycle with adult cuff at 25°C (77°F) with power save mode enabled) from full charge. Time for full recharge: 1 hr 50 min from full discharge when the Monitor is switched off and 8 hrs when Monitor is switched on.

2.6.2. Environmental

OPERATING TEMPERATURE	+ 5° C to + 40° C (+ 41° F to + 104° F)
OPERATING ATMOSPHERIC PRESSURE RANGE	700 to 1060 hectoPascal
STORAGE TEMPERATURE	– 20° C to + 50° C (– 4° F to + 122° F)
STORAGE / TRANSPORTATION ATMOSPHERIC PRESSURE	500 to 1060 hectoPascal
HUMIDITY RANGE	0 % to 95 % non-condensing
RADIO FREQUENCY	Complies with IEC Publication 601-1-2 (April 1993) Medical Electrical Equipment, Electromagnetic Compatibility Requirements and Tests, and CISPR 11 (Group 1, Class A) for radiated and conducted emissions.
INGRESS OF LIQUIDS	The Monitor is protected against vertically falling drops of water and conforms with the IEC 529 standard at level of IPX1. No harmful effects will come of vertically falling drops of water making contact with the Monitor.

2.6.3. Mechanical

DIMENSIONS	Height Width Depth	9.8 in. (25.0 cm) 9.8 in. (24.8 cm) 6.9 in. (17.5 cm)
WEIGHT including battery	7.8 lb (3.5 kg)	
MOUNTINGS	Self-supporting on rubber feet or pole mountable	
PORTABILITY	Carried by recessed handle or pole mounted	
CLASSIFICATION INFORMATION	Mode of Operation: Continuous Degree of Protection against harmful ingress of water: Drip-proof IPX1	

2.6.4. NIBP

CUFF PRESSURE RANGE	Adult Neonate	0 mmHg to 290 mmHg 0 mmHg to 140 mmHg	
DEFAULT TARGET: CUFF INFLATION	Adult Neonate	160 ± 15 mmHg 110 ± 15 mmHg	
TARGET CUFF INFLATION ADJUSTMENT RANGE	Adult Neonate	100 to 250 mmHg 5 mmHg increments 100 to 140 mmHg 5 mmHg increments	
BLOOD PRESSURE DETERMINATION TIME	Adult Neonate	120 seconds maximum 85 seconds maximum	
PULSE RATE RANGE	Adult Neonate	30 – 200 BPM 30 – 200 BPM	
OVERPRESSURE CUT-OFF	Adult Neonate	300 – 330 mmHg 150 – 165 mmHg	
BLOOD PRESSURE MEASUREMENT RANGES	Systolic mmHg	MAP mmHg	Diastolic mmHg
Adult Neonate	30 - 245 40 - 140	15 – 215 30 – 115	10 - 195 20 - 100
BLOOD PRESSURE ACCURACY	Meets AAMI/ANSI standard SP-10 AAMI/ANSI standard: ± 5 mmHg mean error Intra-arterial method: ± 8 mmHg standard deviation		
PULSE RATE ACCURACY	± 3.5 percent		

2.6.5. Temperature

SCALES	Celsius	Fahrenheit
RANGE Max Min	42.2 °Celsius 31.6°Celsius	108.0° Fahrenheit 88.9° Fahrenheit
MONITOR MODE ACCURACY	± 0.1°C	± 0.2°F (when tested in a calibrated liquid bath; meets ASTM E1112, Table 1, in range specified)
PREDICTIVE MODE ACCURACY	± 0.6°C	± 1.0°F
DETERMINATION TIME	Less than 60 seconds	

2.6.6. SpO_2

SpO_2 RANGE AND ACCURACY	adult/neonate: 70% to 100% ± 3.5 digits
	adult/neonate: 0% to 69% ± (unspecified)
PULSE RATE RANGE AND ACCURACY	30 BPM - 250 BPM ± 3 BPM
SATURATION PITCH INDICATOR	Pitch changes with saturation Volume selectable from 0 (off) to 9
WAVEFORMS	Pulse plethysmograph waveform on LCD gain compensated
SENSOR CONNECT / DISCONNECT FROM PATIENT	The monitor detects the attachment or disconnection of a sensor from the patient within 15 seconds
SENSOR CONNECT / DISCONNECT FROM MONITOR	The monitor detects the attachment or disconnection of a sensor from the Monitor within 5 seconds
PULSE DETECTION	The monitor detects a pulse or enters a no signal state within 15 seconds of being attached to the patient
LOSS OF PULSE	The monitor detects loss of pulse from patient and enters a no signal state within 10 seconds

NELLCOR SENSORS

ADULT ACCURACY (70% - 100%)	**ACCURACY**
OXICLIQ-P pediatric sensor	2.5 digits
OXICLIQ-I infant sensor	2.5 digits
OXICLIQ-N neonatal/adult sensor	2.5 digits
OXICLIQ-A adult sensor	2.5 digits
OXIBAND pediatric/infant sensor	3.0 digits
OXIBAND adult/neonatal sensor	3.0 digits
DURA-Y ear clip	3.5 digits
REFLECTANCE sensor	3.5 digits
DURASENSOR adult	3.5 digits
PEDI-CHECK pediatric spot-check clip	3.5 digits
OXISENSOR II D-20 pediatric sensor	2.0 digits
OXISENSOR R-15 adult nasal sensor	3.5 digits
OXISENSOR II D-25 adult sensor	2.0 digits
OXISENSOR II N-25 neonatal/adult sensor	2.0 digits
OXISENSOR II I-20 infant sensor	2.0 digits
OXISENSOR II D-25L adult sensor, long cable	2.0 digits

Neonatal Accuracy **NOTE: Refer to NELLCOR sensor specifications**	When sensors are used on neonatal subjects as recommended, the specified accuracy range is increased by ± 1 digit to account for the theoretical effect on oximeter measurements of fetal hemoglobin in neonatal blood, e.g., N-25 accuracy on neonates is ± 3, rather than ± 2.

SECTION 3. THEORY OF OPERATION

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SECTION 3. PRINCIPLES OF OPERATION

3.1 INTRODUCTION

This section provides overall theory of operation and functional description of the DINAMAP PRO Monitor (hereinafter referred to as PRO Monitor). The PRO Monitor comes in four different models, as follows:

- PRO Monitor 100 - It has the capability of monitoring Blood Pressure (BP) and Pulse
- PRO Monitor 200 - It has the capability of monitoring BP, Pulse, and Temperature
- PRO Monitor 300 - It has the capability of monitoring Blood Pressure (BP), Pulse, and SPO2
- PRO Monitor 400 - It has the capability of monitoring BP, Pulse, Temperature, and SPO2

3.2 OVERALL PRINCIPLES OF OPERATION

The following paragraphs provide a general system interface relationship. The general block diagram is located in Figure 3-1.

The PRO Monitor is a portable unit that receives input power from an external AC source, external DC source, or internal rechargeable battery.

When the ON/OFF button is pressed, the Main Board is brought out of a sleep mode and turns on the power regulators. The power regulators provide conditioned power from one of the input power sources: AC Mains, External DC, or the Lead Acid Battery. The regulated power is routed to the Printed Wiring Assemblies (PWAs) via the cable harnesses. Once the Pro Monitor is energized, a self-test is performed. The self-test automatically tests the main functions of the PRO Monitor. Failure of the self-test will set the PRO Monitor into a fail-safe mode with an audio alarm.

Under normal operating condition, the PRO Monitor is ready to record the patient vital signs using three

external attachments: the temperature probe, SPO2 sensor, and cuff. Interface with a central station or other device is accomplished through the host communication port on the back of the Pro Monitor.

3.2.1 SPO2 (Model 300 and 400)

The SPO2 probe has a built-in sensor. When the SPO2 sensor is attached to the SPO2 connector and patient, the probe senses the heart rate and oxygen saturation. These analog signals are routed to the SPO2 PWA. The analog signals are analyzed on the SPO2 PWA. The results are digitized and sent to the Main Board via opto couplers. The couplers provide for patient isolation as well as serial data interface. The Main Board temporarily stores the data and routes it to the appropriate displays and/or printer.

A reset signal to the SPO2 PWA is also provided so that the power up sequencing is corrected. If the SPO2 circuit quit communicating to the Main Board, the Main Board will attempt to reset the SPO2 PWA.

3.2.2 Cuff Blood Pressure (BP) and Pulse

When the cuff and hose are attached to the Pro Monitor and Non-Invasive Blood Pressure (NIBP) determination is initiated, the pump inflates the cuff. Pressure transducers PT1 and PT2 monitor pressure information. The pneumatic manifold has two valves, which are used to deflate the cuff. Valve control is through the Main Board. Once determinations are made for the systolic BP and diastolic BP, the Main Board calculates the pulse rate/Mean Arterial Pressure (MAP). The results are then displayed on the front panel (seven segment Light Emitting Diodes (LEDs)) and sent to the printer.

The Pneumatic Valve/Manifold (PVM) device has an overpressure sensor built-in to protect against over-inflation. If an over-inflation condition occurs, the OVERPRESSURE signal is routed to the PVM to release the air pressure. The Main Board also, generates an alarm condition with the speaker sounding and a message in the Liquid Crystal Display (LCD).

3.2.3 Temperature (Model 200 and 400)

When the TEMPERATURE probe is attached to the temperature connector and patient, TEMP input is

routed to the Main Board. This input represents the temperature to be measured. The Main Board converts the TEMP signal to a DIGITAL signal. During the conversion, the Main Board determines the patient temperature. The patient temperature is distributed as a DIGITAL signal to the LED display or printer in Celsius or Fahrenheit.

3.2.4 Host Communication Port

The Host Comm Port is used to interface the Monitor with other electronic devices (a central nurse's station or remote alarm device.) Signals can be sent to the Monitor to initiate blood pressure determinations and other functions. Patient data can also be retrieved through this port. For further information, reference the Dinamap Pro 100-400 Series Host Communication manual.

3.3 FUNCTIONAL DESCRIPTION

The following paragraphs provide the functional interface relationship. The Pro Monitor contains a number of electrical & electro-mechanical assemblies. These assemblies are:

- Power Supply Unit (PSU) PWA
- PSU Module
- Main Board
- SPO2 PWA (optional)
- Pneumatic control device
- Liquid Crystal Display (LCD) Assembly
- Printer PWA w/printer

3.3.1 PSU PWA

The PSU PWA is a low voltage DC power supply. The PSU PWA is designed to operate from the output of the AC MAINS PSU module, EXTERNAL DC line source, or from a 12-volt rechargeable lead-acid battery. When the PSU PWA receives the EXTERNAL DC, a portion of that voltage is routed to an analog input of the Secondary Processor. The Secondary Processor uses this signal to determine the available power sources. If a valid external power source is available, LED lights to indicate that external

power is available. If an external power source exists, and a battery source is detected, the Secondary Processor will send a command to turn on the Battery Charger circuitry. If there is no external power source or the external power source is below the required voltage, the PSU PWA will automatically default to use the battery. Since the Pro Monitor is now operating from the battery voltage, a sample of the battery source is applied to Analog Digital Converter (ADC) circuit of the Secondary Processor. From this, the Secondary Processor can determine the charge state of the battery.

3.3.2 PSU Module

The PSU module is an AC Mains to DC converter. The PSU module receives AC power from an external source. When AC INPUT is applied to the PSU module, the module AC/DC Converter changes the AC INPUT supply via rectifier circuit to a high voltage DC. The DC power is then routed through a high frequency switching converter and regulated to 24 vdc. This supply is connected to the PSU PWA for further regulation.

3.3.3 Main Board

The Main Board is configured with Programmable Read Only Memory (PROM), Random Access Memory (RAM), LED Display, Hard Keys, 16 Bit ADC, Primary Processor, and Secondary Processor. The Primary Processor services and controls the Patient Parameter Interface (PPI) devices and display backlighting. The Secondary Processor controls the seven segment LED display, sound generation, real time clock, and system timing verification. The processors receive DC power from the PSU PWA. When the PPI devices transmit analog data to the Main Board A/D converter, the Primary Processor perform algorithm calculations. Once all the calculated parameter values are compiled, the data is then transmitted to the LCD and printer via Secondary Processor. Concurrently, the calculated parameter values are being stored in the non-volatile RAM. Calibration and other variable settings are stored in the Electrically Erasable Programmable Read Only Memory (EEPROM).

The Main Board backup voltage, derived from either NiMH battery or an external power source, appears on the Main Board supervisory circuit. The Main Board supervisory circuit generates the RESET and HALT signal for the Primary Processor. It also, allows EXTERNAL DC voltage to the RAM and Secondary Processor when the system is ON or battery backup voltage to power the RAM and Secondary Processor when the system is OFF.

If the Primary Processor fails to reset its watchdog timer, the Primary Processor sends a low level on its watchdog output to the Pneumatic Control Gate Array Logic (PCGAL). If the Primary Processor detects system faults or overpressure, it will notify the Secondary Processor of system failure condition. The Secondary Processor in turn, sends a FAILSAFE signal to the PCGAL and Tone Generator. When the PCGAL receives the FAILSAFE signal, it sends a DEFLATE signal to the Pneumatic Valves to depressurize the system to atmosphere. Once the Tone Generator receives the FAILSAFE signal, it sends an audio frequency (ALARM signal) to the speaker. During the failsafe mode the following will also occur:

- Parameter monitoring disabled
- Remote alarm control inactive
- Graphic LCD displays fault error code
- Pneumatic safe state (deflate the cuff, pump off)
- Normal communications interface disabled
- Hard keys and rotary switch inactive

When a low or high ambient room lighting occurs, the Primary Processor uses it’s supervisory circuit to increase or decrease the graphic backlighting, automatically.

3.3.4 SPO2 PWA (Optional)

The SPO2 PWA provides continuous readings of oxygen saturation and pulse rate. Additional circuitry provides power, data communications, and isolation between SPO2 PWA and Primary Processor.

Patient data received from the finger sensor is filtered, amplified, and analyzed on the SPO2 PWA. The

information is sent to the Main Board via the optically coupled electrically isolated serial connection. The Primary Processor receives the data and distributes it to the appropriate display. The data is also sent to the printer via the Secondary Processor.

3.3.5 Pneumatic Control Device

The Main Board transducers PT1 and PT2 sense cuff pressure and raw oscillatory information. The analog signals are amplified, buffered, and sent to an Analog to Digital (A/D) Converter. The converter changes the analog signals to digital signals and routes these signals to the Primary Processor. The Primary Processor receives the digital signals via the data interface.

Appropriate valve and pump control signals are sent from the Primary Processor to the PCGAL. The PCGAL then generates the appropriate drive signals to the pump and valves.

If a failsafe mode or overpressure condition occurs, the PCGAL provides the appropriate control signals to insure a safe condition, where the cuff vents to atmosphere pressure.

3.3.6 LCD Assembly

The LCD assembly is used as a message center. It displays patient vital signs, alarm status, monitor set-up, limit violation, BP cycle and the time the data was received. The Primary Processor controls the LCD assembly. When the parameter signals are read by the Primary Processor, it decodes these signals and routes the digitized signals to the graphic LCD.

The LCD assembly is equipped with a variable lighting feature for the graphic display. The Primary Processor controls the lighting feature, automatically. When a low or medium ambient lighting condition occurs, the Primary Processor sends a BACKLIGHT signal to adjust the graphic display lighting with respect to the room lighting condition. If the lighting condition is high, the Primary Processor sends a BACKLIGHT_1 signal to switch off the graphic display lighting.

3.3.7 Printer PWA w/Printer

The Printer PWA w/printer communicates to the Primary Processor via Secondary Processor data line.

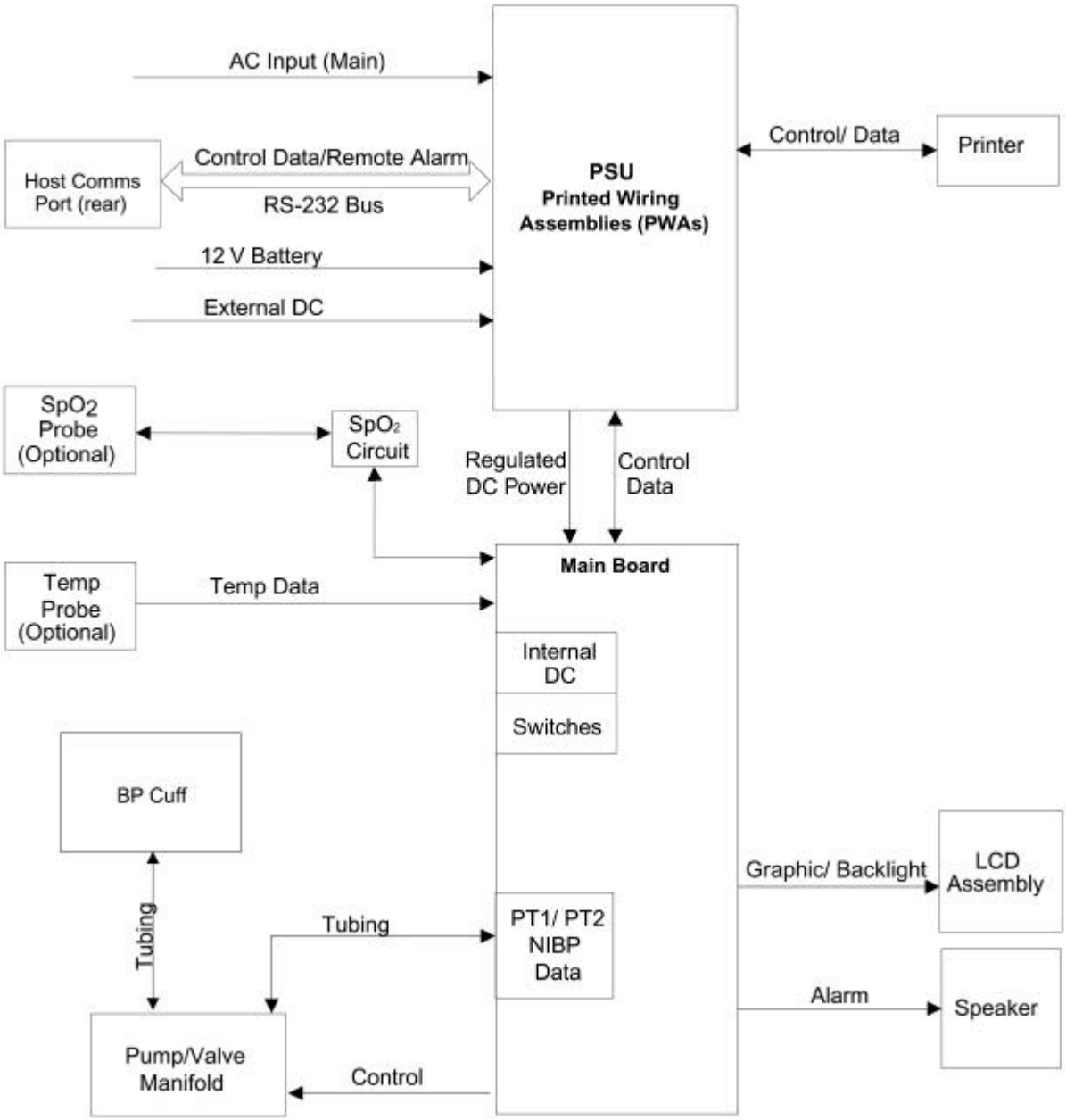
The printer receives power from the Main Board via the Printer PWA. The printer sends a DATA OUT (CONTROL DATA) signal to the Secondary Processor to notify of it's presence. When a print command is sent to the printer from the Secondary Processor, the following will occur:

- CLOCK signal - transfer the data into print head
- DATA IN - serial dot to be printed
- LATCH signal - latch the data stream into the head
- STB1-6 - cause the head to print various sections

Together these signals (CONTROL DATA) cause the printer to print a graphic hardcopy of the patient vital sign values and trend data. It also causes the printer to print hardcopy of error logging and service record data.

The printer has a built-in sensor to monitor the printer paper level. When the printer is out of paper, it sends a PAPER OUT signal to the Secondary Processor.

FIGURE 3-1 GENERAL SYSTEM DIAGRAM



SECTION 4. GENERAL MAINTENANCE

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SECTION 4. GENERAL MAINTENANCE

4.1. INTRODUCTION

This section contains maintenance procedures for the DINAMAP® PRO Series 100-400 Monitor, including description of the software screens and menus used to adjust, configure and check the Monitor. Also included are procedures to re-calibrate the NIBP, and adjust the overpressure points.

Procedures pertaining to SpO_2 and temperature functions apply only to PRO Monitors equipped with these features.

4.2. FUSES

The PRO Monitor power circuits incorporate five fuses. None of the fuses are externally accessible. Two mains fuses are mounted on the AC Mains converter board, and are not serviceable by user.

If a mains fuse blows, the monitor will not change from battery power to mains power when it is plugged in to an AC power source. To confirm a fuse problem, remove the battery, plug the unit in, and turn it on. If the PRO Monitor does not operate, the probable cause is an open fuse. Mains fuses should only be replaced by a qualified service technician.

The other three fuses are:

- FS1 - Self resetting; DC input; PSU board
- FS2 - Self resetting; Battery; PSU board
- FS3 - Self resetting; Host port power; PSU board

4.3. PERIODIC MAINTENANCE

Periodic maintenance tasks include cleaning the PRO Monitor, checking pressure calibration, pneumatic leakage, pneumatic system overpressure point, the temperature calibration (PRO Monitors 200 and 400), and verification of the SpO_2 system (PRO Monitors 300 and 400).

4.3.1 Cleaning the Monitor

The exterior of the PRO Monitor may be wiped clean with a cloth slightly dampened with mild detergents or standard hospital bactericides.

Cleaning with isopropyl alcohol or similar solvents is not recommended.

Do ***not*** immerse unit.

Do ***not*** immerse hoses.

Do ***not*** immerse cuffs without prior application of cuff hose caps.

CAUTION

Moisture or foreign substances introduced into the pneumatic system will cause damage to the unit. Calibration equipment should always be kept dry and clean.

4.3.2 Power Up Checks

When the PRO Monitor is powered up, it conducts a series of self-tests to ensure that the displays and other functions are operating normally. Some malfunctions generate fatal errors and put the Monitor in Failsafe mode. In this mode, the patient monitoring features are disabled. Other malfunctions do not interfere with normal operation, but should be repaired at the next opportunity.

As part of a periodic maintenance routine, observe the power-up self tests, and service as required.

LED Display Check

All seven segments of the LED bulbs are illuminated during the power up sequence. The segments light in a sequence beginning with the upper left segment.

LCD Display and LCD Back Light Check

Observe the LCD during power up. Confirm that all of the pixels on the LCD display are lit momentarily, and the back light is powered during initialization. The backlight is only noticeable in a dimly lit room. Confirm that the display indicates the software version in inverted format (white on black).

NIBP Calibration Check

If the NIBP system is uncalibrated, the Monitor boots directly to service mode and displays a service menu. Refer to 4.10 PRO Monitor Calibration Procedures, page 4-17.

Speaker Check

During power up, the audio system generates three short beeps, followed, after a brief pause, by three more beeps. If the speaker generates distorted, or no sound, it is faulty.

Remote Alarm Switching Check

When the PRO Monitor is off, the remote alarm switches to an alarm state. The system clears the alarm state during power up. If the remote alarm does not change states, it is faulty.

4.3.3. External DC Supply and Battery

The power indicators on the lower left on the front of the PRO Monitor show the source and charge status of the battery. The external power indicator LED continuously glows green to show the battery is charging.

The indicator flashes every four seconds to show an external power source is connected, but is not charging the battery. Either a battery is not installed or the external DC input voltage is too low.

1. Power on, and wait for the Pro Monitor to initialize. Confirm that the external power indicator is lit and the battery LED is extinguished.
2. Remove the battery and confirm that External DC LED on Monitor flashes.
3. Fit the battery and disconnect the external power supply. Confirm the external power indicator extinguishes, the battery LED glows yellow, and the battery icon appears on the LCD, toggling with the time indicator. If the battery power is low, the battery LED flashes every four seconds, and the battery icon on the LCD changes.
4. Reconnect the external power supply, verify that the battery LED extinguishes.

4.3.4. Care Of The Storage Battery

It is best to keep the battery charged as fully as practical. Never store the Monitor with the battery in a discharged condition. When the battery no longer holds a charge, remove and replace with one of the same part number.

PRECAUTIONS

To ensure that the battery is ready for portable operation, keep the unit connected to AC mains whenever possible. Repeated failure to fully charge the battery significantly reduces battery life. Avoid storing batteries at temperatures above 77° F (25° C). High storage temperatures can dramatically increase the self-discharge rate of battery.

4.3.5. Checking NIBP Calibration

Perform the test procedures described in 4.8, page 4-15 every 12 months, or whenever the accuracy of any of the parameters is in doubt.

4.4 SERVICE MODES AND MENUS

The PRO Monitor operates in three service modes, each allowing different levels of access to the Monitor functions, set up, and calibration. These modes are accessed from the **More…** option on the Main menu, and require a code before a user can access them.

The **Clinician Mode** enables the user to:

- Toggle between Celsius and Fahrenheit
- Verify NIBP calibration dates
- Change the alarms to “Permanent Silence” mode.

This section provides an overview of the Clinician menus. For more information and details of operation, see the *PRO Monitor Operation Manual.*

The **Service Mode** provides the features allowed from the Clinician menu, and adds these functions:

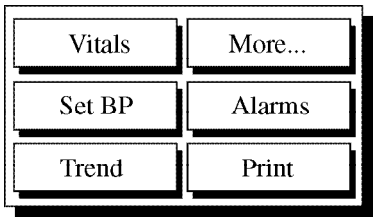
- Check the NIBP calibration
- Re-calibrate NIBP
- Adjust the pneumatic system overpressure point
- Configure communications with a host computer
- Change the language of operation

The **Super Service Mode,** or diagnostics mode, allows the technician to perform more advanced tests on the pneumatic system. The other menu options within this mode are for hardware tests and diagnostics purposes. For information reagarding the other options in Super Service mode, contact Critikon Technical Support at 877-CRITIKON.

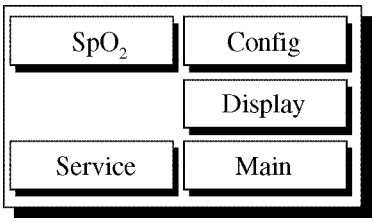
4.4.1 Accessing the Service Menus

To enter a service menu from the Main Menu, use the rotor control and LCD.

1. Select the **More…** button



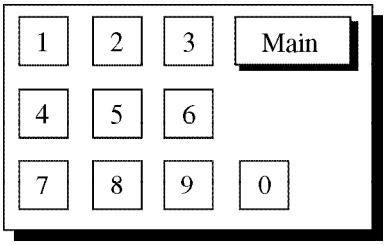
2. Select the **Service** button



3. Enter the access code on the numeric screen.

The service menus require a four-digit access code. Rotate the select knob to highlight a number, and push to make a selection.

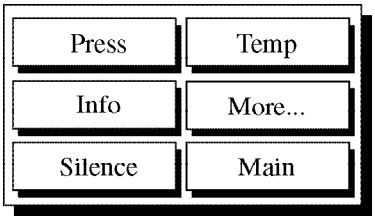
The access codes:



1 2 3 4 To access the Clinician Menus
2 2 1 3 To access the Service Menus
8 3 7 8 To access the Super Service Menus

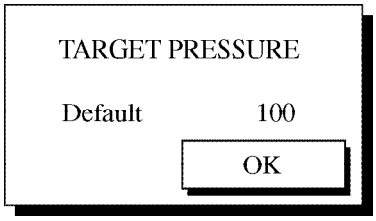
4.5 CLINICIAN MODE AND MENUS

4.5.1 Clinician Mode Main Menu



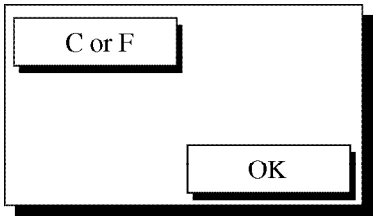
The Clinician Mode Main menu, pictured above, provides access to the options normally required for routine use of the PRO Monitor. The individual buttons on this menu are described briefly below.

Press Button



Selecting the **Press** button displays the target pressure dialog box, pictured above, which sets the default target inflation pressure for an NIBP cycle. The factory default is 160 mmHg for adults and 110 mmHg for neonates. This is indicated by the “AUTO” label at either end of the adjustable range.

Temp Button

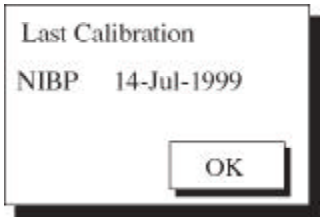


Selecting the **Temp** button displays the dialog box which toggles the temperature units of the Monitor between Celsius and Fahrenheit. When Celsius is selected, the °C indicator lights. When Fahrenheit is selected, the °F indicator lights. Click on **OK** to save the selection.

CAUTION

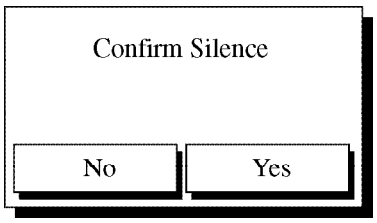
Changing temperature units will clear the trend readings. Before the readings are cleared, a dialog box requests the user confirm or cancel the change.

Info Button



Selecting the **Info** button displays the most recent calibration dates of the NIBP. Click **OK** to return to the Service menu.

Silence Button



Selecting the **Silence** button displays the dialog box, pictured above, which mutes **all** the alarms except the failsafe alarm. The alarms are disabled until the Monitor is either powered off and on again, or the Alarm Silence button is pressed. Either **Yes** or **No** will exit the menu. If silence is confirmed, the Alarm Silence button illuminates.

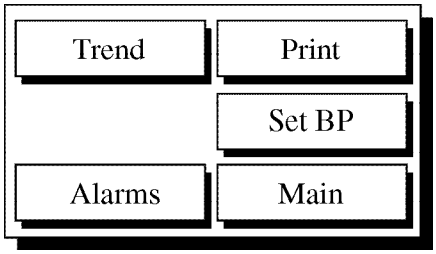
More … Menu Button

The Clinician *More…* menu accesses controls which allows the user to permanently change the default settings.

Main Button

Select this button to exit the service menu and return to the Main Menu.

4.5.2 Clinician More… Menu



The Clinician More… menu, pictured above, accesses the software controls to change the default settings of several PRO Monitor functions. These options are summarized below.

Trend Button

Displays a dialog box to automatically clear trend data on power up. The default setting is **Yes**. In the default setting, trend data is cleared when the PRO Monitor is shut off. Select **No** to retain the trend data on power-down.

Print Button

Displays a dialog box to restore the print mode on power up to user-selected print mode (auto or manual) or the default print mode. The print mode can be selected through the print

button on the Main menu. The current mode is displayed in the lower right corner on the LCD. Select **No** and the PRO Monitor powers up in manual print mode. Select **Yes**, and the monitor retains the user-selected mode.

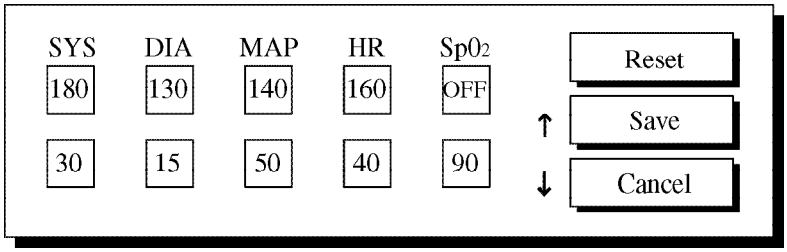
Set BP Button

Displays a dialog box to power up in a user-selected BP mode (auto/ manual). Select **Yes** to preserve the user-selected BP mode. Select **No** to power up the PRO Monitor in manual mode.

Alarms Button

This button accesses a dialog box to enter the alarms configuration menu**.** Selecting **Yes** enters the menu. Selecting **No** returns the user to the *More…* menu.

4.5.3 Alarms Configuration Menu



Select **Reset** to return all the alarm limits to the default settings. The illustration above shows the default settings.

The user can adjust these alarm points within the high and low limits specified in the table below, subject to the following conditions.

- The high limit cannot equal the low limit
- The high limit cannot be less than the low limit.
- The low limit cannot be greater than the high limit.
- The high and low limits are not permitted to be within a step size (see table - next page) of each other.

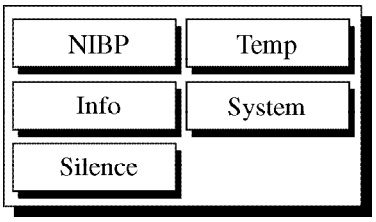
Parameter	Range	Default
Systolic High	35 - 245	180
Systolic Low	30 - 240	30
Diastolic High	15 - 195	130
Diastolic Low	10 - 190	15
MAP High	20 - 215	140
MAP Low	15 - 210	50
Heart Rate High	35 - 250	160
Heart Rate Low	30 - 245	40
SpO_2 High	51 - 100	Off
SpO_2 Low	50 - 99	90

Note: Predictive temperature has no alarm limit alarm.

Select **Save** to save the displayed settings and return to the *More…* menu. Select **Cancel** to abandon any changes and return to the *More…* menu.

4.6 SERVICE MODE AND MENUS

4.6.1 Service Mode Main Menu

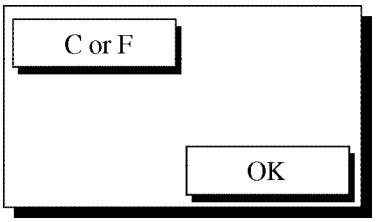


The controls accessed through the Main Service menu; pictured above, allow the technician to check basic functions of the PRO Monitor, calibrate the NIBP system, and set the language of operation. These menus and adjustments should be used only by qualified service technicians.

NIBP Button

The NIBP button accesses the NIBP Service menu. Use this menu to calibrate and check the NIBP transducers and the overpressure circuitry.

Temp Button



The **Temp** button on the Main Service menu accesses a

dialog box, pictured above, which toggles the temperature measurement units between Celsius and Fahrenheit. If the unit of measurement is changed, a warning appears to inform the user that this change clears trend information from memory. **OK** returns the display to the Main Service menu.

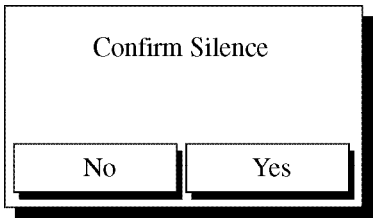
Info Button

This button displays the date of the most recent NIBP calibration. Select **OK** to return the display to the Service menu.

System Button

This button accesses the system service menu. The controls on this menu set the display language, communications protocols, test the EEPROM, and print the error log.

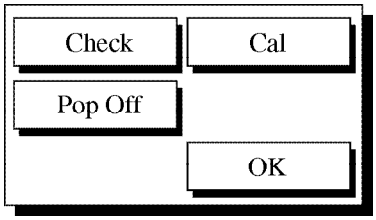
Silence Button



Selecting the **Silence** button displays a request to confirm the choice. This is a working option available only through the Clinician Mode (1234.) Alarms are disabled when in Service Mode.

Yes mutes **all** patient alarms until the PRO Monitor is powered off and on again, or the Alarm Silence button is selected again to enable the alarms. A confirmation menu appears (pictured above) on the display. Selecting either **Yes** or **No** exits the menu. If silence is confirmed, the Alarm Silence button on the front panel illuminates momentarily.

4.6.2 NIBP Menu



The options on the NIBP menu, pictured above, are used to calibrate and test BP functions of the PRO Monitor.

Check Button

This button allows the NIBP calibration to be checked. In this mode, the PRO Monitor functions as a digital manometer. The systolic LED displays the output of PT1, and the diastolic LED displays the output of PT2. The overpressure point is set to the adult value.

With no hose attached the systolic and diastolic displays will indicate “000.” See 4.10, page 4-17 for a more detailed description of this mode and the calibration procedure.

Cal Button

This button initiates the calibration procedure. See 4.10, page 4-17 for a step-by-step description of this procedure.

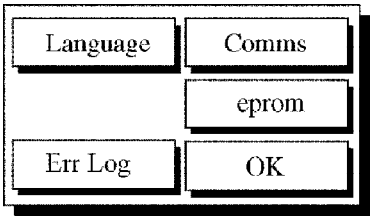
Pop Off Button

This button functions in a similar manner to the **Check** button, but the overpressure point is set to the neonate value. See 4.12, page 4-20 for a more detailed description of using this function.

OK Button

This button returns the display to the Main Service menu.

4.6.3 System Menu



The System Menu, pictured above, accesses the software controls which modify the basic configuration of the PRO Monitor, test the EEPROM, and print the error log.

Language Button

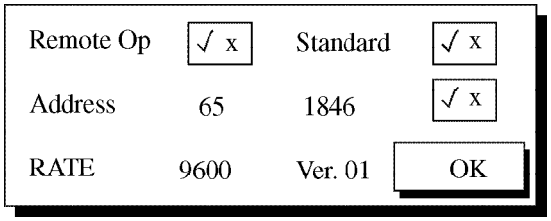
This button displays the language choices. The language dialog boxes are not pictured. The PRO Monitor software can display menus in eight languages: UK, USA, German, French, Spanish, Italian, Portuguese, and Dutch.

Selecting any language button removes all other language buttons from the screen, indicating that the remaining button is the chosen language. Selecting **Clear** restores all the language buttons, allowing the user to select again. **OK** saves the selection and requests that the monitor be turned off. If no language is selected when **OK** is pressed, the language is stored as undefined. In this case, the Monitor prompts the user to select a language on every power up until a selection occurs.

Comms Button

This button accesses the Communications menu. The settings on this menu configure communications with a host computer when PRO Monitors are connected to a network.

Comms Menu



The **Remote Op.** check box toggles remote operation. When on, a check mark (√) appears in the box, the PRO Monitor responds to external commands, and can initiate an NIBP determination when prompted by a host computer. Remote operation requires DINAMAP® Host Communications Protocol, which is described in the DINAMAP® *Host Communications Reference Manual*.

The **Standard** check box sets the host comms protocol to standard format, and the baud rate at 9600 bps.

The **Address** box sets the Monitor address within a range of 32 to 126. Address 32 is not unique. All monitors, regardless of unit address, respond to commands to unit address 32.

Selecting the **1846** button sets the comms protocol to 1846 format, and the baud rate to 600 bps.

The baud **Rate** can be set to 300, 600, 1200, 2400, 4800, 9600, or 19200.

Select **OK** to return to the Main Service menu.

eprom Button (EEPROM Testing)

This button initiates a test of the read and write functions on the EEPROM. The test is repeated 20 times. The results are displayed on the LCD and recorded in the error log.

Err Log Button

This button generates a printout of the last 20 system errors that have occurred on the unit. The system and secondary processor software versions are also listed on the error log.

4.7 SUPER SERVICE MODE AND MENUS

The Super Service menu is used to conduct hardware tests and diagnostic routines. The applicable hardware tests are listed in 4.13, page 4-21.

4.8 PRO MONITOR CALIBRATION PROCEDURES

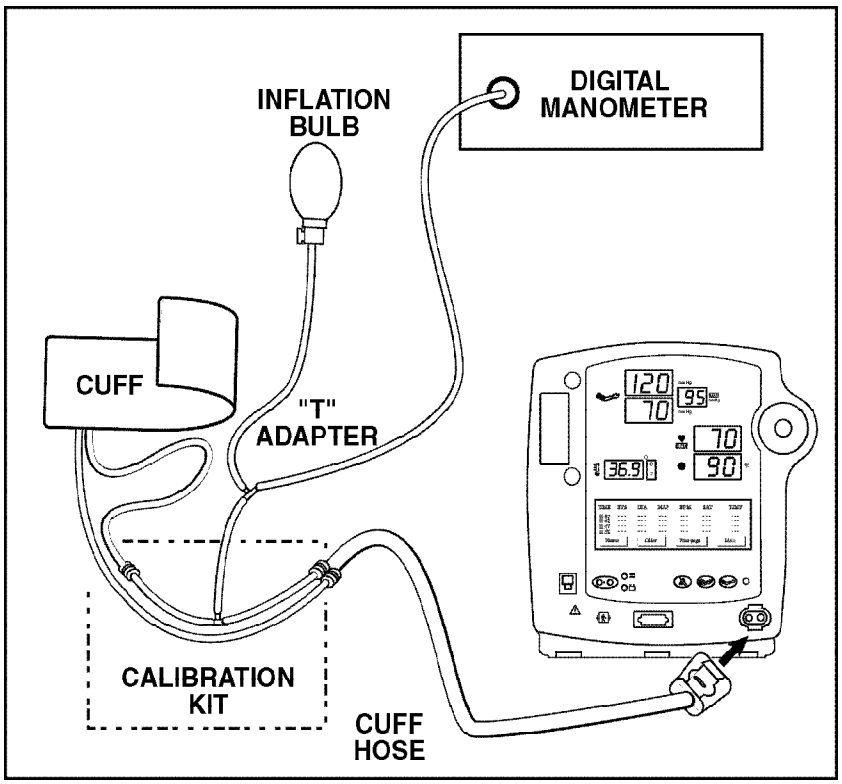


Figure 4-1. Calibration Check Set Up

Calibration procedures include verification of the NIBP calibration, calibration of the pneumatic system, and verification and adjustment of neonatal and adult overpressure points. These tests require a manometer and a pump attched to the PRO Monitor as shown in Figure 4-1, above. An adult blood pressure cuff wrapped around a semi-rigid cylinder may be used.

4.9 NIBP CALIBRATION CHECK

The BP calibration of the PRO Monitor should be checked every 12 months or whenever the validity of the NIBP readings is in doubt. Use a CRITIKON calibration kit (Part #320246) or equivalent equipment. Verifying the accuracy of the NIBP parameter does not require disassembly of the PRO Monitor.

Equipment Required

- NIST Calibrated Digital One-Tube Manometer calibrated to ±.5mm Hg
- Bulb pump or syringe
- Calibration Kit (P/N 320246)

Set Up the Test

1. Attach the calibration equipment as shown in Figure 4-1.
2. Power on the PRO Monitor and allow 10 seconds to initialize.
3. Verify that the calibration pressure measurement system reads 0 mmHg (0 mb).

NOTE

The PRO Monitor may display the language choice menu along with instructions to turn the monitor off. If this error occurs, choose the desired language and **OK**. Reboot the system by turning PRO Monitor off and back on.

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4. Select the **More…** button from the Main menu
5. Select the **Service** button.
6. Enter the Service mode access code **2 2 1 3** to access the service menus.
7. Select **NIBP** from the service menu.
8. Select **Check** from the NIBP service menu.

   In this mode, the PRO Monitor displays pressures on the systolic and diastolic displays. Apply pressure to the system with the pump, and verify that the digital displays on the monitor agree with the readings on the manometer, with a specified tolerance of ±3 mmHg, plus tolerance of the manometer.

Upper and Lower Pressure Ranges		
Display	**Description**	**System Range**
Systolic	Pressure measured at PT1 (main pressure transducer, on main board)	0 mmHg - 300 mmHg
Diastolic	Pressure measured at PT2 (on pump assembly)	0 mmHg- 330 mmHg

Overpressure occurs before 330 mmHg. Pressure can not be measured above the overpressure set point.

Normal operation is not possible until the PRO Monitor is powered off and back on.

4.10 CALIBRATING THE NIBP SYSTEM

The following procedure describes the steps required to calibrate the PRO Monitor. Disassembly is not required.

4.10.1 The NIBP Calibration Procedure

1. Set up the Monitor and calibration equipment as shown in Figure 4-1.
2. Power on the PRO Monitor.
3. Verify that calibration equipment reads 0 mmHg (0 mb) of pressure.

NOTE

If the PRO Monitor displays the language choice menu, select a language. Select **OK** and reboot the system.

4. Select the **More…** button from the Main menu.
5. Select the **Service** button.
6. Enter the Service Mode access code **2 2 1 3**.
7. Select the **NIBP** button from the Service menu.

IMPORTANT

From this point, the timing is critical. Before proceeding, review the following steps.

Setting the Calibration Points

1. Select **Cal** from the NIBP menu.
2. The Monitor displays Set Pressure to 0 mmHg.
3. Ensure calibration test equipment is at 0 mmHg.
4. Press **Accept** to continue or **Cancel** to quit this procedure.
5. The Monitor displays Set Pressure to 200 mmHg.
6. Apply the pressure (200 mmHg) and HOLD the pressure. Press **Accept** to continue or **Cancel** to quit this procedure.
7. If Accept is chosen, the monitor will vent the system to atmosphere. Immediately prior to venting, the monitor stores the set pressure reading into system memory.

The zero reading and the 200 mmHg reading are the only points used for calibration. It is important to ensure that the correct pressures are applied at these two points.

After venting, the Monitor displays "**Calibration Complete**" or "**Calibration Failed**."

If the calibration fails, turn off the Monitor, check the calibration equipment and repeat the process. Refer to a CRITIKON service representative if calibration is still unsuccessful. When the calibration is successful, the PRO Monitor enters a "Failsafe Alarm" mode (audible solid tone). The PRO Monitor is accurately calibrated and can be switched off.

Check the calibration of unit by repeating procedure in 4.9, page 4-16.

4.11 NEONATE/ ADULT OVERPRESSURE CHECKS

The following procedures describe how to verify the pressure at which the Monitor over-pressure detection system prevents further cuff inflation and generates an alarm.

Set up the test

1. Attach the calibration equipment as shown in Figure 4-1.
2. Power on the PRO Monitor.

Verify that calibration equipment is at 0 mmHg (0 mb) of pressure.

4.11.1 Neonate Overpressure Check

1. Select the **More…** button from the Main menu.
2. Select the **Service** button.
3. Enter code **2 2 1 3** to access the service menu.
4. Select the **NIBP** button from the Service menu.
5. Select the **Pop Off** button from the NIBP menu.
6. Apply pressure to the NIBP system with the bulb, pump, or syringe.

NOTE

If the PRO Monitor displays the language choice menu, select a language. Select **OK** and reboot the system.

Observe the pressure at which the dump valve opens and count the time required for the pressure to fall to less than 20 mmHg.

Verify that the maximum pressure, as shown on the calibration equipment, is within the range of 150 mmHg - 165 mmHg at overpressure and the system pressure falls to less than 20 mmHg within 4 seconds.

CAUTION

For the adult overpressure check, ensure that the calibration pressure measurement system is capable of displaying pressures up to 350 mmHg safely.

4.11.2 Adult Overpressure Check

1. Attach the test equipment and power up the PRO Monitor in similar manner as the previous tests.
2. Select the **More…** button from the Main menu.
3. Select the **Service** button.
4. Enter code **2 2 1 3** to access the Service menu.
5. Select the **NIBP** button from the service menu.
6. Select the **Check** button from the NIBP service menu.
7. Apply pressure to the NIBP system with either a bulb, a pump, or a syringe.

Observe the pressure at which the dump valve opens and count the time required for the pressure to fall to less than 20 mmHg.

Verify that the maximum pressure, as shown on the calibration equipment, is within the range of 300 mmHg - 330 mmHg at overpressure and the system pressure falls to less than 20 mmHg within 8 seconds.

4.12 OVERPRESSURE ADJUSTMENT

This procedure describes how to set the overpressure setting – the pressure at which the Monitor automatically opens the valves and stops the pump. Only the neonatal can be set, as monitor doubles the user-defined neonatal setting to set the adult overpressure setting.

Adjusting the overpressure is **only** possible by opening the PRO and adjusting the overpressure pot. on the Main board.

Equipment Setup

1. Open the case and access the Main board, as described in Section 5 of the PRO Monitor service manual.
2. Locate the overpressure adjustment potentiometer (VR1) at the upper right of the Main board. The adjustment is secured with adhesive applied during manufacturing.
3. Set up the PRO Monitor and calibration equipment as shown in Figure 4-1.
4. Power on the PRO Monitor.
5. Verify that the calibration pressure measurement system reads 0 mmHg (0 mb).

NOTE

If the PRO Monitor displays the language choice menu, select a language. Select **OK** and reboot the system.

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6. From the Main Menu, select the **More...** button.
7. Select the **Service** button from the More… menu.
8. Enter access code **2 2 1 3** to display the service menu.
9. Select the **NIBP** button from the Service menu.
10. Select the **Pop Off** button from the NIBP menu. This button sets the overpressure point to the neonate value.
11. Apply pressure to the system with the bulb, pump, or syringe until the valve opens and releases the pressure.

The point when the valve opens should be 157 +/-1 mmHg. If the overpressure point is too low, turn the potentiometer

clockwise to raise the overpressure. If the point is too high, turn the potentiometer *counterclockwise* to lower the point. Repeat the procedure until the overpressure is within the limits specified above. Re-secure the adjustment with adhesive. The adult overpressure point is double the neonate value.

4.13 PRE-SERVICE TEST PROCEDURES

The following procedures can be used to check the primary functions of the PRO Monitor before releasing the unit for clinical service.

The Monitor is tested by applying various stimuli to the sensor interfaces or measuring of specific parameters. The test procedures employ features of the operational software and the test modes of the Service Menus.

A guide to the PRO Monitor controls, indicators and connectors is in Section 2 of the PRO Monitor service manual.

Test Equipment

1. Digital Pressure Gauge 0-375mmHg, 0.2% accuracy, Digitron P200L or similar.
2. NELLCOR* SpO_2 Simulator Model SRC-2, PT2500 or N1290 or similar.
3. NIBP Calibration Kit CRITIKON P/N 320246, or similar.
4. IVAC** Probe Simulator, P/N 193737, Alaris Medical Systems.

Test Conditions

Testing shall be conducted with an ambient temperature of 25 °C ± 5 °C (77 °F ± 9 °F).

Service Modes

During several procedures the operator needs to enter the Service mode or the Super Service mode. The Monitor can be switched into these modes by using the following procedures.

Selecting Service Mode

1. From the Main menu select the **More…** button.
2. From the sub menu select the **Service** button.
3. Enter access code **2 2 1 3** to display the Service menu.

* NELLCOR is a trademark of Mallinkrodt, Inc.

** IVAC is a trademark of Allaris Medical Systems.

Selecting Super Service Mode

1. From the Main menu select the **More…** button.
2. From the sub menu select the **Service** button.
3. Enter the access code **8 3 7 8** to display the Super Service menu.

4.13.1 SpO_2 Checks (PRO 300 & 400)

These procedures apply only to the PRO 300 & 400. The SpO_2 parameter should be tested once a year at the minimum and whenever the SpO_2 appears to be out of tolerance.

Pulse Data and Saturation Data Verification

1. Connect a NELLCOR pulse simulator (model SRC-2, PT-2500 or N-1290) to simulate an SpO_2 sensor.
2. Power on the PRO Monitor.
3. From the Main Menu, select the **Alarms** button.
4. Set the BPM upper limit to 250.
5. Set BPM lower limit to 10.
6. Set SpO_2 upper limit to OFF.
7. Set SpO_2 lower limit to 50.
8. If using a NELLCOR N-1290 simulator, connect the simulator cabling to the PRO and power it on.
9. Test the PRO Monitor using the full range of saturation and pulse rate settings available on the simulator. Confirm that the unit readings are within the tolerances defined below.

Pulse Search Verification

Set the pulse rate to zero on the NELLCOR simulator. Verify the "No SpO_2 Signal" message is displayed on the PRO Monitor LCD. Acknowledge the message by pressing rotor switch.

Probe Disconnected Verification

1. After a period of normal operation with a heart rate of 90 applied, remove the SpO_2 sensor from the simulator, verifying that a "No SpO_2 Signal" message is displayed on the Main LCD.
2. Acknowledge message by pressing the rotor switch.
3. Remove the SpO^2 sensor from the PRO, verify that "No SpO_2 Sensor" message is displayed
4. Acknowledge message by pressing the rotor switch.
5. Power down the PRO Monitor.

4.13.2 NIBP Calibration Check

This procedure verifies the linearity and calibration for both pressure transducers (PT1 and PT2) across the range from 0 (-0 to +3) mmHg to 250 (± 3) mmHg.

1. Set up the unit and calibration equipment as shown in Figure 4-1.
2. Power on the PRO Monitor and select **More...**
3. Select the Service mode and input **2 2 1 3**.
4. From the Service menu, select the **NIBP** button.
5. From the NIBP menu, select the **Check** button.
6. Apply the following pressures (measured by an external digital manometer) and confirm that the Monitor readings agree with the following table for both PT1 and PT2 channels.

PT1 & PT2 Linearity Check

Applied Pressure mmHg	Measured Pressure mmHg (on Monitor)
0	0 -0 to +3
50	50 ±3
100	100 ±3
150	150 ±3
200	200 ±3
250	250 ±3

If calibration is required, refer to 4.10.1, “Calibrating the NIBP,” page 4-17.

Neonate Overpressure Check

1. Set up the unit and calibration equipment as shown in Figure 4-1.
2. Power on the PRO Monitor and select **More...**
3. Select the Service mode and input **2 2 1 3**.
4. From the Service menu, select the **NIBP** button.
5. Increase applied pressure until over pressure occurs. Confirm that pressure at that point is between 150 mmHg to 165 mmHg, and system pressure falls to less than 20 mmHg within 4 seconds.
6. Power down the PRO Monitor.

7. If the overpressure point is out of range, adjust the overpressure potentiometer as described in 4.12, page 4-20.

Adult Overpressure Check

1. Set up the unit and calibration equipment as shown in Figure 4-1.
2. Power on the PRO Monitor and select **More...**
3. Select the Service mode and input **2 2 1 3**.
4. From the Service menu, select the **NIBP** button.
5. Select the **Check** button.
6. Increase applied pressure until overpressure occurs. Confirm that pressure at the overpressure is between 300 mmHg and 330 mmHg, and the system pressure falls to less than 20 mmHg within 8 seconds.
7. Switch off the PRO Monitor and disconnect the calibration kit.
8. If the Monitor fails this test, re-calibrate the unit as described in section 4.12, page 4-20.

4.13.3 Temperature System Check (PRO 200 & 400)

The PRO Monitor Series 200 & 400 predictive temperature systems use ALARIS Model 2080 temperature probes with IVAC technology. This system is self-calibrating. The only maintenance required is to verify that the temperature functions are working properly. These checks require an IVAC probe simulator (P/N 193737), available from ALARIS Medical Systems, Inc., San Diego, CA. Critikon does not stock this tester.

To check the temperature system, connect the IVAC probe simulator to the temperature probe connector on the front panel, and insert a temperature probe into the active holster.

1. Power on the PRO Monitor.
2. Remove the temperature probe from the probe holster to initiate a temperature reading.

Set the probe simulator to 80.2 and verify that the LCD temperature display reads 80.2°F ±1.0°F. The numbers on the temperature LED displays should be flashing at this point, indicating the monitor is in a real-time monitor mode.

A range of temperatures can be checked, by using the other values on the probe simulator (98.0, 98.6, 102.0, and 107.8).

Broken Probe Sensing

Set up the equipment and the probe simulator as in the previous procedure. Rotate the temperature selector to B.P. verify that the Temperature display reads 106.0F° ±0.2°F. Next. press BROKEN PROBE on the simulator, verify that the LED display on the monitor changes to four dashes, indicating a fault condition.

If the PRO Monitor temperature system does not pass these tests, the Main PWA needs to be replaced.

4.13.4 Overpressure Threshold Measurement

1. Set up the unit and calibration equipment as shown in Figure 4-1.
2. Power on the PRO Monitor and select **More...**
3. Select the Service mode and input **8 3 7 8**.
4. From the Super Sertvice Menu, select the NIBP button,
5. From the NIBP menu, select the ThRef Buton
6. This function measures the adult and neonatal overpressure threshold levels and reports them on the Main LCD as ADUs.

4.13.5 Leak Test

This test performs a leak test of the pneumatic system.

1. Set up the unit and calibration equipment as shown in Figure 4-1.
2. Power on the PRO Monitor and select **More...**
3. Select the Service mode and input **8 3 7 8**.
4. From the Super Sertvice Menu, select the NIBP button,
5. From the NIBP menu, select the **Leak** Buton

The leak-test sequence closes both valves and turns the pump on. The PRO monitor will self-pressurize the pneumatic test setup to approximately 200 mmHg. After 5 seconds, the target pressure value will be displayed in mmHg on the LCD. The system holds the pressure for approximately 36 seconds and continues to display the current pressure on the LCD. Confirm that the pressure has fallen no more than 5 mmHg.

4.13.6 Printer Test

This test generates a sample printout from the printer. If no paper is in the printer, the Monitor generates no alarm.

1. Power on the PRO Monitor and select **More...**
2. Select the Service button and input **8 3 7 8**.

3. From the Super Sertvice Menu, select the **Print** button,

Ensure the printed test page is clear and easy to read.

4.14 ELECTRICAL SYSTEM SAFETY CHECKS

The PRO Monitor is designed to protect the patient from exposure to harmful levels of electricity. To ensure the integrity of these safeguards, use a safety analyzer and feed 253 vac into the system. A current-leakage test must be performed on every unit whenever the case is opened for repairs, and before it is returned to clinical service. If the reading exceeds the maximum tolerance as specified below, do not return the unit to clinical service.

Normal Polarity

At normal polarity, test open ground and open neutral. The leakage reading should be <500uA.

Reverse Polarity

At reverse polarity, test open ground and open neutral. The leakage reading should be <500uA.

Temperature System Leakage (PRO 200 & 400)

Use a temperature plug with the leads shorted and apply test voltage to the leads. The leakage reading should be <50uA.

SpO_2 System Leakage (PRO 300 & 400)

Use an SpO_2 plug with the leads shorted together. The leakage reading should be <150uA.

Perform these four checks when repairs are completed, and prior to returning the monitor to clinical service.

4.15 TROUBLESHOOTING

Trouble	Probable Causes	Fault Isolation
Monitor will not switch on when powered by battery	Battery may be discharged PSU board fault	Measure terminal voltage of the battery Swap PSU board
Unit will not switch on from either battery or External AC source	On/Off switch/rotor faulty +5Vdc supply low	Try turning on by pressing the rotor switch. If monitor switches on, check On/Off signal from switch to the Main board. Measure +5Vdc supply on PSU
Pressing rotor switch fails to power on the unit, menu selection is possible	Rotor on/off switch assy	Replace rotor switch assy
No rotor repsonse	Rotor failure Main board failure	Swap rotor assy Swap Main board
When rotor is turned, menus are skipped	Rotor failure Main board failure	Swap rotor assy Swap Main board
Incorrect, illegible, or no LCD output	LCD fault Main board fault (usually accompanied by an audible alarm if Main board processor has ceased operation) Negative supply to LCD (-9.6 Vdc) is out of tolerance	Swap LCD Swap Main board Check negative supply reaching the LCD module
No LCD backlight	LCD faulty Main board fault	Swap the LCD Swap the Main board
Incorrect, missing segments,or no LED display output	Main board fault (usually accompanied by an audible alarm if Main board processor has ceased operation) No or Low +4 Vdc LED supply	Swap Main board Swap PSU board Check supply continuity from PSU board to Main board

Trouble	Probable Causes	Fault Isolation
"SpO_2 probe disconnected" error displayed on LCD	Faulty finger probe/extender cable Faulty internal SpO_2 internal cabling Faulty SpO_2 PWA	Test parameter with known good accessories Swap or test internal cabling Swap PWA and test unit with NELLCOR SpO_2 simulator
Following the monitor power-up sequence, a failsafe alarm sounds, and one of the following messages appears on the LCD: System error, P105 System error, P110 System error, P115	Faulty SpO_2 PWA Isolated power supply module failure on Main board Main board processor SpO_2 RS-232 comms failure	Swap SpO_2 PWA and reinspect the monitor Verify +5Vdc isolated power supply is within specification Swap Main board and reinspect the monitor
Overpressure warnings displayed on LCD when NIBP is initialized (with or without a cuff and hose)	Kinked air hose or faulty cuff Partial or full blockage of internal pneumatic hosing	Inspect cuff and hose for blockages Inspect the pneumatic assy for a blocked output Swap the pneumatic assy
At NIBP start, the pump sounds labored, generally accompanied by one of the following messages: N33-NIBP: Inflation Timeout N00-NIBP: Overpressure	Kinked air hose or faulty cuff Blocked or kinked hose from pump output to the front panel Pneumatic assembly failure	Test with known good accessories Examine hosing for kinks or blockages Inspect pneumatic assy for blocked output Swap pneumatic assy
TSH_HW:PIC displayed on the Main LCD	Monitor has failed temperature self-calibration.	Swap Main board.
Pump Over Current 0, (code line failure),0,0	A pump over-current condition has been signaled to the Main board processor Pump current sensing circuitry failure on the Mian board Pump failure	Swap the Main board Swap pump assy
Unit does not respond to host communications	PSU board unresponsive	Swap PSU board Check continuity of PSU board to the host comm port cable on the rear panel

Alarm Code	LED Display	LCD Description	Audible Tone and Volume	Effect of Alarm Silence Switch	Effect of Clear Via *Select*-Knob	Probable Cause
N99	Values zeroed. Dashes in NIBP windows.	N99- NIBP FAILED	High priority alarm. Volume adjustable.	2 minute silence	Clear	Unable to register NIBP measurement due to an insufficient signal.
N55	Values zeroed. Dashes in NIBP windows.	N55- TIMEOUT: PRESSURE	High priority alarm. Volume adjustable.	2 minute silence	Clear	One cuff pressure >1 minute. Motion arifact.
N44	Values zeroed. Dashes in NIBP windows.	N44- TIMEOUT: TOTAL	High priority alarm. Volume adjustable.	2 minute silence	Clear	Determination time >2 minutes. Motion Artifact.
N33	Values zeroed. Dashes in NIBP windows.	N33- TIMEOUT: INFLATION	High priority alarm. Volume adjustable.	2 minute silence	Clear	Inflation time >40 seconds or air leak detected.
N00	Values zeroed. Dashes in NIBP windows.	N00- OVERPRESSURE	High priority alarm. Volume adjustable.	2 minute silence	Clear	Overpressure state detected.
No Code	No change	LOW BATTERY- with flashing battery icon.	3 beeps every 10 seconds. Volume adjustable	2 minute silence	No effect	Replace/ recharge the battery. From onset of alarm, 5 NIBP readings available. Beep rate increases as the battery discharges.
No Code	Blank	LOW BATTERY- SYSTEM DISABLED	Steady tone. System is disabled.	No effect	No effect	Replace/ recharge the battery. Monitoring halted.
No Code	No change	PRINTER- NO PAPER	High priority alarm. Volum adjustable.	2 minute silence	Clear	Replace paper or close printer door
No Code	Values posted	NIBP RANGE ERROR	High priority alarm. Volume adjustable.	2 minute silence	Clear	NIBP algorithm value outside target range.
Other: N, P, E, I, S	Blank	Error Code, with Description	Steady tone, Maximum volume	No effect	No effect	Internal system fault.

Alarm Code	LED Display	LCD Description	Audible Tone and Volume	Effect of Alarm Silence Switch	Effect of Clear Via *Select*K-nob	Probable Cause
P55	Values zeroed. Dashes in SpO_2 window.	P55 - SpO_2 NO SIGNAL	High priority alarm. Volume adjustable.	2 minute silence	Clear	No or very weak SpO_2 signal. Check or reposition sensor.
P00	Values zeroed. Dashes in SpO_2 window.	P00- NO SpO_2 SENSOR	High priority alarm. Volume adjustable.	2 minute silence	Clear	SpO_2 sensor not connected. No sensor detected. Sensor failure.
No Code	No change	SpO_2 PLACEMENT?	High priority alarm. Volume adjustable.	2 minute silence	Clear	SpO_2 signal weak or noisy. Sensor failure.
No Code	Values zeroed	SpO_2 CABLE?	High priority alarm. Volume adjustable.	2 minute silence	Clear	SpO_2 sensor or cable possibly defective. Cable not connected properly.
E33	Dashes in Temp windows.	E33 - TEMP: FAIL	High priority alarm. Volume adjustable.	2 minute silence	Clear	Temperature probe not connected or inoperable
E00	Dashes in NIBP windows.	E00 - TEMP: FAIL	High priority alarm. Volume adjustable.	2 minute silence	Clear	Predictive temperature determination > 60 secs or attempting axillary temp
No Code	Blank	HIGH TEMP	High priority alarm. Volume adjustable.	2 minute silence	Clear	Predictive temperature reading exceeds upper range limits

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SECTION 5. COMPONENT INFORMATION & PART LISTS

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SECTION 5. COMPONENT INFORMATION & PART LISTS

5.1. INTRODUCTION

The Critikon PRO Monitor is designed in a modular configuration, with subassemblies, that can be quickly and easily replaced. The case breaks down into two halves: the front case assembly and the rear case assembly. The PWAs (printed wiring assemblies) and mechanical assemblies are attached to these and connected by tubes and cables. Using the Trouble Shooting hints in Section 4 and the technical descriptions in Section 3, malfunctions can easily be isolated to a specific subassembly. Refer to the parts list in this section for part numbers.

The Front Case assembly includes:

- Main PWA
- SpO_2 PWA
- LCD assembly
- Rotor knob and shaft
- Fascia

The Printer Module subassembly includes:

- Printer PWA (printer interface)
- Printer
- Printer housing, door, and door latch

The Rear Case assembly includes:

- Speaker assembly
- PSU Module (AC to DC Converter)
- PSU PWA (Low Voltage Power Supply)
- Pump/manifold assembly
- Pump bracket
- Battery door

The illustrations and component information in this section pertain to the PRO Series Model 400, which includes all four functions: BP, pulse, temperature

and SpO_2. If a function in not installed on the unit in service, simply disregard the sections that are not applicable. The basic disassembly procedures and replacement part numbers apply to all the models in the PRO Monitor series.

5.2. GENERAL PRECAUTIONS

Before beginning disassembly, disconnect the line power cord from the mains input connector and remove the rechargeable lead-acid battery.

When working with circuit boards, protect them from electrostatic discharge. The main PWA contains microprocessors and memory modules, which can be easily damaged by electrical surges.

Pay special attention to the ribbon cables and hoses. When repairs are complete and the unit is reassembled, ensure that the cable connectors are firmly attached and the hoses are not pinched or kinked.

Keep the work area clean. It is easy to scratch the front plastic display panel with a screw or other sharp object.

5.3. TOOLS REQUIRED

5mm socket wrench or standard pliers

#1 Philips screwdriver

#2 Philips screwdriver

Small flat-head screwdriver

Needle-nose pliers

Torx drivers sizes T7 and T10

5.4. BATTERY

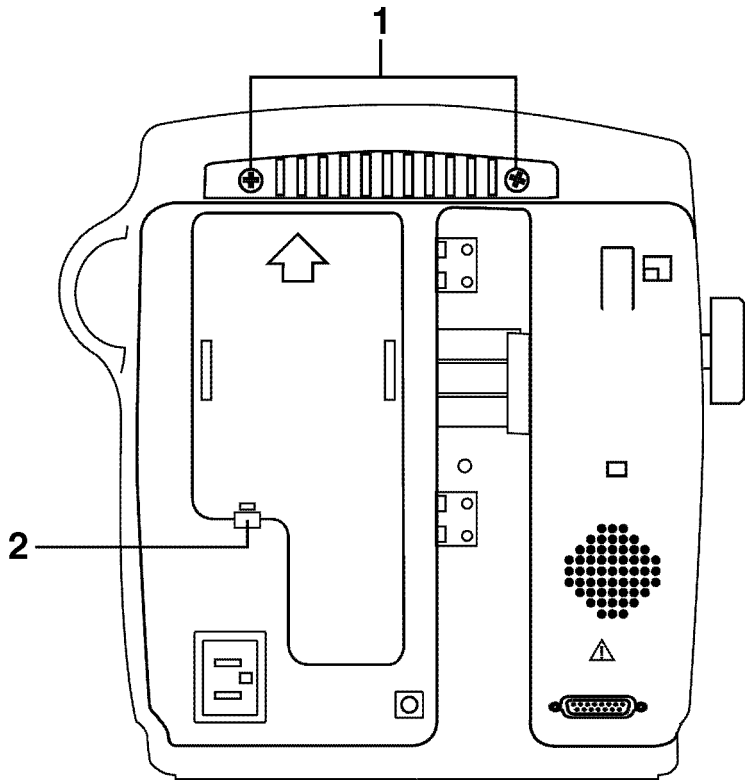


Figure 5-1. Rear view. To remove the battery compartment cover, depress the latch (2) and push the arrow up. The front and rear case are secured by screws (1) inside the hand recess.

COMPARTMENT COVER

The battery compartment is covered by a molded plastic door, which is secured by a latch. The latch release lever is located at the lower left of the door. See Figure 5-1.

5.5. REPLACING THE FASCIA

A common problem with the fascia is fading images and icons. These are printed on the fascia membrane, and should stay bright and clear for many years. Avoid cleaning the equipment with alcohol, and strong solutions. See Section 1 for the recommended cleaning agents and procedures.

New fascias are available (see the Parts List, page 5-16), and the old fascia peels off.

To prevent switch actuators and the light diffusers from falling out during the fascia removal place the monitor on it's back To remove the old fascia, lift one corner, and carefully pull the material to separate it from the front case. The new fascia applies more evenly to a clean surface and has a more aesthetic appearance. If residual adhesive remains on the front case, rub it off. Do not use chemical solvents. They may damage the plastic.

To apply a new fascia, peel the backing, align the corners and press the new fascia into place, being careful not to trap air bubbles between the membrane and the front case.

5.6. OPENING THE CASE

The front and rear case assemblies are secured by two Philips screws located inside the hand recess at the top of the rear enclosure. See Figure 5-1.

To open the unit, remove these two screws. Turn the unit around, with the front forward, and carefully tilt the front case assembly forward. The two halves of the unit are connected at the bottom. When the front panel is at about 45°, the two halves separate. Be careful not to stress the wiring connectors when you separate the front case from the rear case.

5.7. NIBP PNEUMATIC HOSES

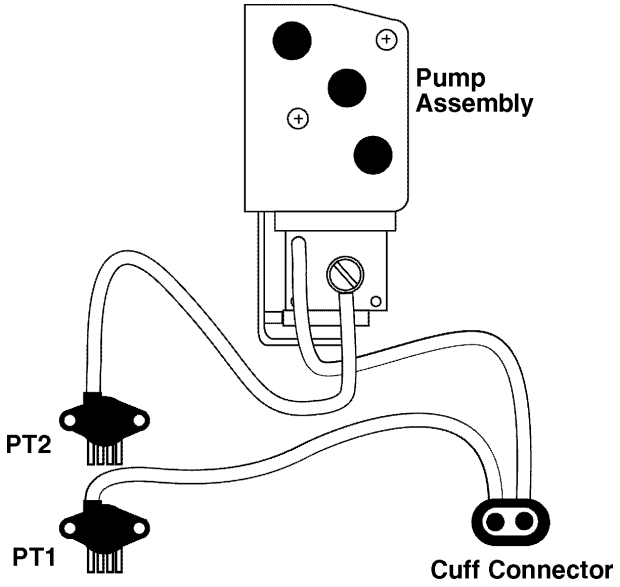


Figure 5-2. Pneumatic system layout. The main BP readings are derived from transducer PT1. Transducer PT2 confirms the reading and triggers the overpressure signal.

Three pneumatic hoses link the BP cuff, the pump and the transducers, which generate an analog signal to calculate the BP readings. If the hoses are not connected correctly, the Monitor will not operate properly.

It is also important to make sure that the hoses are not kinked or pinched when the front and rear cases are reassembled. Replace the cable tie affixing the hose to the pump manifold.

5.8. WIRING HARNESSES

Most of the physical interconnections between the PWAs and other subassemblies are via cables or bundled wires. The SpO_2 PWA connects directly to the Main PWA via a 5-way pin connector. The Main PWA connects to the LCD module via a 20-way pin connector.

5.8.1. PSU Interconnection

DC power: 2-way (red/black) from PSU Module to PSU PWA (PL2).

5.8.2. Power Supply to Main PWA

Output: 10-way (red) from PSU PWA (SK8) to Main PWA (PL9).

Supply control signals: 9-way (orange) from PSU PWA (SK5) to Main PWA (PL4).

5.8.3. LCD Power Supply

2-way (red/black) from Main PWA (PL5) to LCD subassembly.

5.8.4. Host Comms

15-pin Host Port connector: 6-way (gray) from PSU PWA (SK6) to Main PWA (PL7).

5.8.5. Alarm Speaker Connection

2-way (black) from Main PWA (PL5) to speaker, runs beneath the PSU PWA.

5.8.6. Pump and Valves Power and Control

7-way (6 pins used, red/black) from Main PWA (PL3) to pneumatic subassembly.

5.8.7. Printer Assembly

Thermal Head: 12-way (blue) from Main PWA (PL1) to Printer Interface PWA (SK5).

Printer Motor/Sensor: 9-way (white) from Main PWA (PL10) to Printer Interface PWA (SK6).

Printer Motor/Sensor: 9-way (multi-colored) from Printer Interface PWA (PL2) to motor/sensor.

Printer Power: 4-way (blue) from PSU PWA (SK7) to Printer Interface PWA (PL12).

Thermal Head Connector: 28-way ribbon cable from Printer Interface PWA (SK4) to print head.

5.9. DISASSEMBLY PROCEDURES

This section describes how to open the case, disassemble the chassis and remove the PWAs and subassemblies. These descriptions and illustration include the circuit boards, connectors, and equipment related to BP, pulse, SpO_2, and temperature functions. However, the procedure applies to all PRO models.

In general, the disassembly must be performed in the order presented here, as some assemblies may block access to the screws and connectors, which attach other assemblies.

5.10. THE FRONT CASE ASSEMBLY

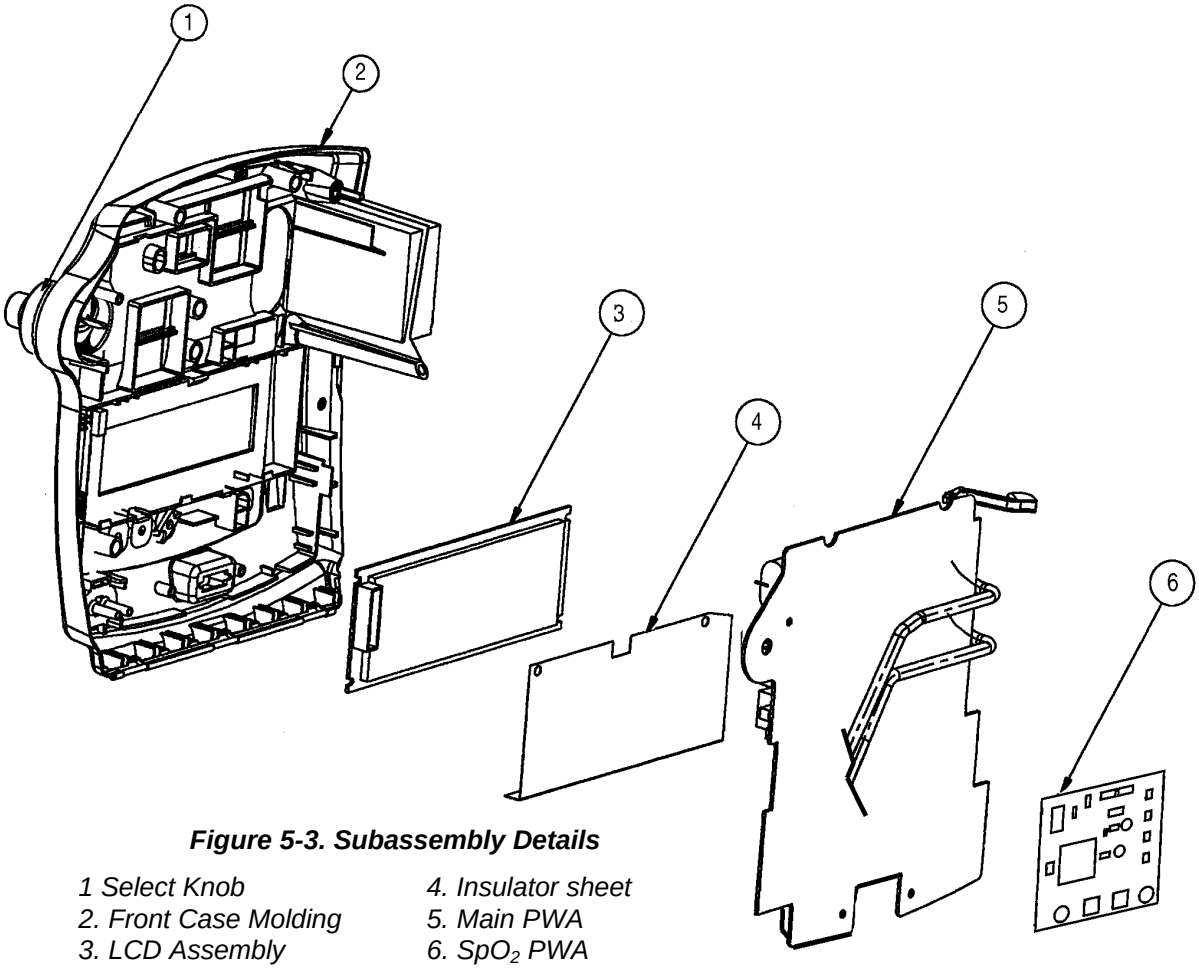


Figure 5-3. Subassembly Details

1 Select Knob
2. Front Case Molding
3. LCD Assembly
4. Insulator sheet
5. Main PWA
6. SpO_2 PWA

5.10.1. Removing the SpO2 PWA

The SpO_2 PWA is attached to back of the Main PWA, and secured with a nylon spacer and two screws, one of which connects an RFI grounding strip to the Main board.

1. Remove the nuts on the SpO_2 PWA.
2. Turn the front case over and remove the two screws that hold the SpO_2 connector.
3. Pinch the nose of the nylon spacer with the pliers and separate the SpO_2 PWA.
4. The SpO_2 PWA plugs into the Main PWA through 2-way and 5-way pin connectors.

5. Carefully pull the SpO_2 PWA until the connector pins are free from the socket.

If the PRO Monitor is equipped with SpO_2, the SpO_2 sensor connector must be detached from the front case before the Main PWA can be removed. If an SpO_2 module is not installed, this port is covered with a plug.

5.10.2. Removing the Main PWA

The Main PWA is secured to the front case by three Torx screws through the back of the board and one retaining clip: two mounts are located at the bottom of the main board, and the remaining mount is near the rotor switch. If SpO_2 is installed, the two screws at the bottom are visible through holes in the SpO_2 card. In addition, the SpO_2 sensor connector is secured to the front case with two Torx screws. These are visible in the SpO_2 port at the lower center of the front case.

1. Remove the cable connectors attached to the Main PWA.
2. **Carefully** remove the pneumatic hoses from the cuff connector and pump manifold.
3. Turn the front case over, and remove the two screws from the SpO_2 port at the bottom center.
4. Remove the three screws holding the Main PWA to the front case.
5. Remove retaining clip by prying it off with small flat screwdriver.

The Main PWA connects to the LCD subassembly through a 20-pin connector (SK3), located on the left, below the rotor switch. Carefully pry the pins on the Main PWA from the connector on the LCD assembly. **CAUTION: Be careful not to break the temperature switch arm when removing the Main PWA.** Lift the Main PWA out of from bottom by tilting it.

5.10.3. Removing the LCD Module

The LCD Module is an integrated unit with display panels attached to a printed circuit board. A latch molded into the front case, at the top center of the board, holds it in place. To remove the LCD subassembly, slip a small flat-head screw driver under the latch and pry it open.

5.11. THE REAR CASE ASSEMBLY

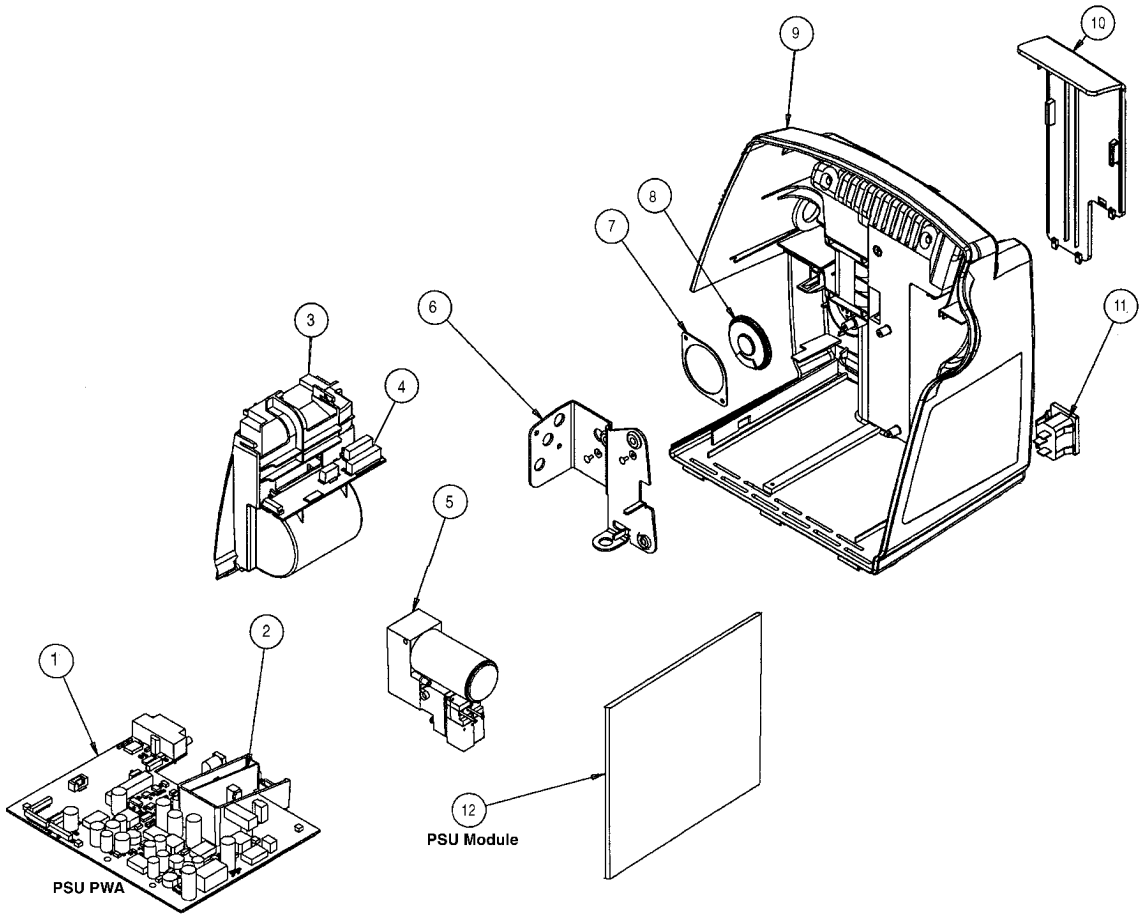


Figure 5-4. Subassembly Details

1 PSU PWA
2. Battery Compartment Base
3. Printer Assembly
4. Printer PWA
5. Pump/manifold Assembly
6. Pump Bracket
7. Speaker Retaining Ring
8. Speaker
9. Rear Case Molding
10. Battery Compartment Cover
11 AC Power Connector
12. PSU Module (represented by blank)

5.11.1. Removing the Pump Assembly

With the printer assembly removed (See page 5-13), the two mounting screws on the pump subassembly bracket are easily accessible. Remove these screws and separate the pump and valve subassembly from the brackets. Two lengths of rubber hose on metal rods help support the pump motor and isolate vibrations. Be careful not to lose these small rubber pieces, as they are not glued to the rods.

5.11.2. Removing the Pump Bracket

The pump assembly bracket must be detached before the PSU PWA can be removed from position in the rear case. Unscrew the three Torx screws holding the metal pump bracket to the rear case. Rubber grommets are used to absorb vibrations.

5.11.3. Removing the PSU PWA

Disconnect the cables to the printer and the Main PWA. The PSU PWA is secured to the rear case by three screws on the board, one located on the front of the board and two screws into the battery compartment base through the bottom of the Rear Case Molding.

Disconnect the DC power input (PL3) from the PSU PWA, and slide the assembly from the rear case.

5.11.4. Removing the PSU Module

The PSU Module slides on grooves molded into the rear case.

1. Remove the retaining clip from the plastic molding at the bottom of the board.
2. Disconnect the shielded power supply cable that runs from the PSU Module to the PSU PWA.
3. Slide the PSU Module from the rear case.

The PSU module is connected to the mains input. Disconnect the mains input lines from the AC power connector.

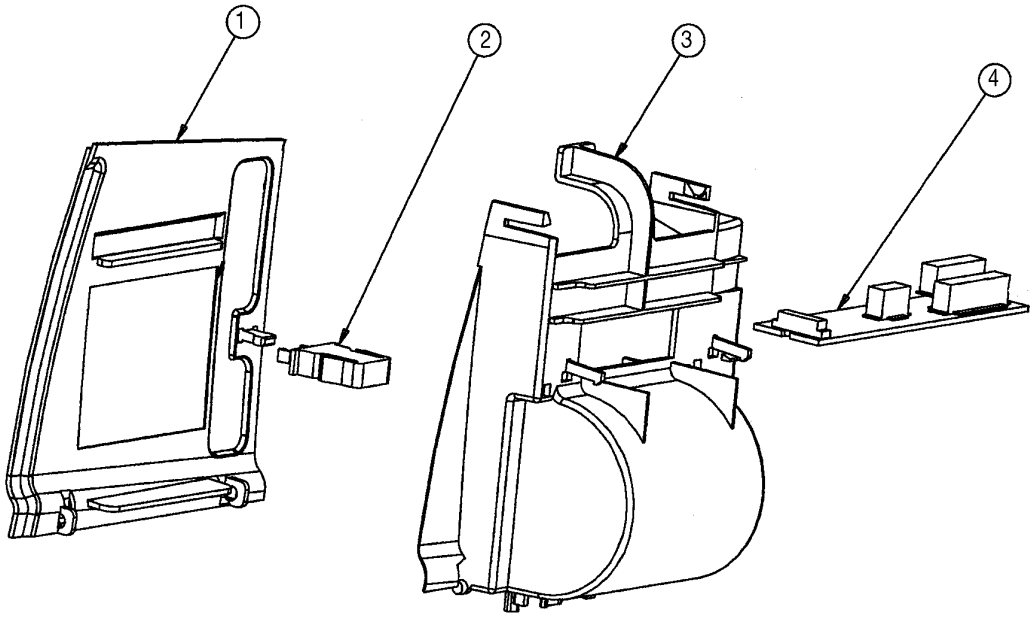


Figure 5-5. Printer Assembly. 1) Door, 2) Latch, 3) Printer Housing, 4) Printer Interface PWA.

5.11.5. Removing the Printer Assembly

The Printer is an integrated unit that includes the housing, door, latch, thermal print head, paper feed, and interface PWA. The printer subassembly slides along rails and guides molded into the rear case. A flexible tab on the printer housing snaps into a slot on the bottom rail and holds the assembly into position.

1. Detach the cables connecting the Printer PWA to the PSU and Main PWAs.

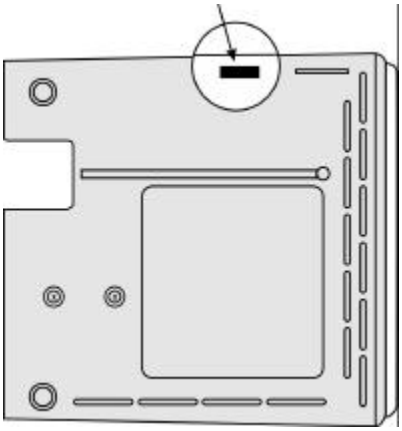


Figure 5-6. Location of the opening in the bottom of the rear case.

2. Access the tab with the blade of a small screwdriver through the opening between the printer housing and the rear case at the bottom of the printer door. It may help to remove the printer

door. The tab is also accessible through an opening in the bottom of the rear case, directly below the printer assembly housing. See Figure 5.6. Insert a small flat-head screwdriver into the opening and move the tab to the left (towards the outside of the rear case) to release the printer housing from the latch.

CAUTION

Do not over flex the printer assembly retention tab, as doing so may cause the tab to break.

3. When the tab is clear of the slot, slide the printer housing out of the rear case.

5.11.6. Removing the Printer PWA

The Printer PWA is a small circuit board mounted on the printer housing and attached to the thermal print head by a 28-way ribbon cable. This interface also provides connectors and wire-to-board connections for other printer functions. Two arms molded into the printer housing secure the Printer PWA. These arms fit into matching holes in the board.

1. Disconnect the cables to the PSU PWA and the Main Board.
2. Remove the Printer PWA from the two plastic arms on the housing.
3. Release the ribbon cable from the print head with the lever on the ZIF socket.

5.12. REASSEMBLY PROCEDURE

Reassembly is a direct reversal of disassembly, however additional care must be taken to ensure that all cables and hoses are reinstalled correctly.

If the hoses are connected incorrectly, the Monitor will not operate. It is also important to make sure that the hoses are not kinked or pinched when the front and rear cases are closed.

The main points to note when reassembling are:

Pay particular attention to the wiring harnesses and pneumatic hoses, and ensure that all components are reinstalled correctly.

- When reassembling the chassis, remember to reconnect the pump to PL3 on the Main PWA.
- When reinstalling the Main PWA and the SpO_2 PWA, ensure that the pins are properly inserted into the matching connectors.
- Ensure that the hoses to the front panel are not pinched or kinked when the two halves of the case are closed.

Check calibration per Section 4 before releasing the Monitor for clinical use. If necessary, recalibrate the Monitor.

5.13. SAFETY CHECKS

After the case is closed, and before returning a repaired PRO Monitor to clinical service, conduct a current leakage test with a safety analyzer, as described in Section 4.

Any time the case is opened, check the integrity of the electrical system with a safety analyzer. To pass these checks, the reading must not exceed the following limits:

Ground Leakage

Normal Polarity

Open Ground	<500uA
Open Neutral	<500uA

Reverse Polarity

Open Ground	<500uA
Open Neutral	<500uA

Temp Leakage

All leads to temperature probe <50uA

SpO_2 Leakage

All leads to SpO_2 probe <150uA

5.14. REORDER PARTS LIST

Description	PN
Actuator Switch	733153
Battery 12V Lead Acid	633132
Battery 3.6V NiMH	633176
Battery Door	748350
Cable, retaining saddle	727175
Case foot	732175
Door latch	732178
Fascia 100 Eur	701495
Fascia 100 US	701499
Fascia 200 Eur	701496
Fascia 200 US	701500
Fascia 300 Eur	701497
Fascia 300 US	701501
Fascia 400 Eur	701494
Fascia 400 US	701492
Flash Memory AM29F040B-70JC	692273
Front case molding non-temperature	701498
Front case molding, temperature	701491
Host/comms cable assembly	316676
LCD Assembly	320748
Main PWA	315585
NOMEX®* insulator	752321
Pneumatic module	320744
Pole clamp circlip	736238
Pole clamp knob	733155
Pole clamp washer	723138
Power cable assembly	316674
Power signal cable assembly	316675
Printer	690178
Printer power cable	316671
Printer PWA	315586
Probe switch hinge	705100
PS retaining clip	736243
PSU module	320746
PSU PWA	315588
Pump retaining washer	723140
Pump/manifold Assy	320744
Rear Case Molding	701493
Rotor Knob	733152
Rotor Shaft	748355
Screw	722237

* NOMEX is a trade name of Du Pont.

Description	PN
Screw, TORX 2.5mmx8	722239
Screw, TORX 3mmx8	722240
Screw, #8 Self-Tapping	722237
Speaker Assembly	320747
SPO2 PWA	315584
Transducer (MPX2050GP)	662176

5.15. ASSEMBLY DRAWINGS

Figure No.	Description
5-7	Front Case Assembly (1 of 2)
5-8	Front Case Assembly (2 of 2)
5-9	Main PWA (front)
5-10	Main PWA (back)
5-11	Rear Case Assembly
5-12	Printer Assembly

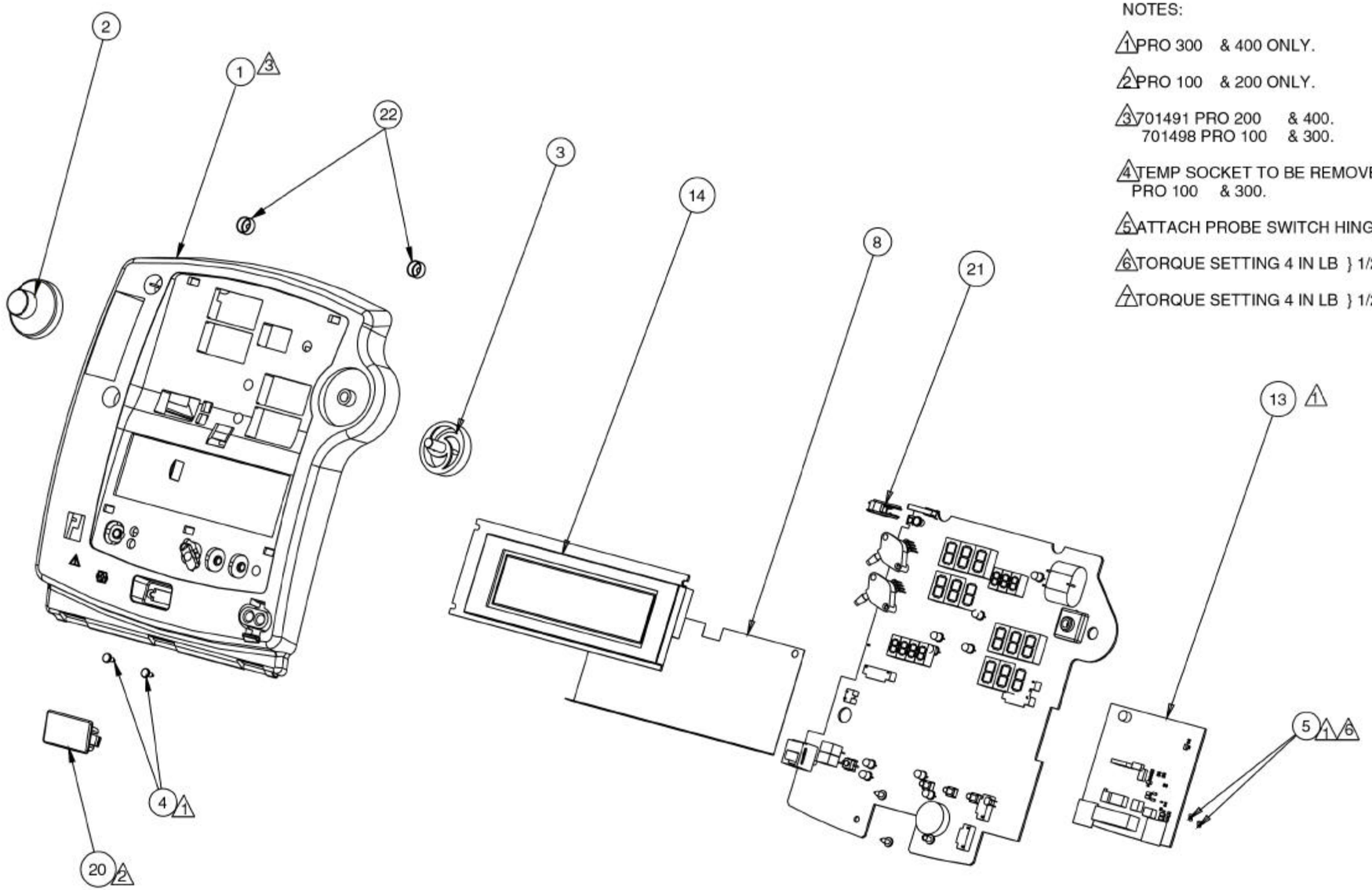
5.16. ELECTRICAL SCHEMATICS

Figure No.	Description	Sheet No.
5-13	Main PWA	1 of 8
5-14	Main PWA	2 of 8
5-15	Main PWA	3 of 8
5-16	Main PWA	4 of 8
5-17	Main PWA	5 of 8
5-18	Main PWA	6 of 8
5-19	Main PWA	7 of 8
5-20	Main PWA	8 of 8
5-21	SpO_2 PWA	1 of 2
5-22	SpO_2 PWA	2 of 2
5-23	PSU PWA	1 of 6
5-24	PSU PWA	2 of 6
5-25	PSU PWA	3 of 6
5-26	PSU PWA	4 of 6
5-27	PSU PWA	5 of 6
5-28	PSU PWA	6 of 6
5-29	Printer Interface PWA	1 of 1

FRONT CASE ASSEMBLY
(1 OF 2)
ILLUSTRATED PARTS BREAKDOWN

Number	Description
1	Front Case Molding
2	Select Knob
3	Select Knob Shaft
4	Screws
5	Nuts
8	Nomex Insulator
13	SpO_2 PWA
14	LCD Assembly
20	SpO_2 opening plug
21	Probe Switch
22	On-Sert retainer

Note: Only the parts included on the Reorder List are replaceable. The components named in the above illustration are for informational purposes only.



NOTES:

1. PRO 300 & 400 ONLY.
2. PRO 100 & 200 ONLY.
3. 701491 PRO 200 & 400.
   701498 PRO 100 & 300.
4. TEMP SOCKET TO BE REMOVED FOR PRO 100 & 300.
5. ATTACH PROBE SWITCH HINGE.
6. TORQUE SETTING 4 IN LB } 1/2 IN LB
7. TORQUE SETTING 4 IN LB } 1/2 IN LB

Figure 5-7
Front Case Assembly (1 of 2)
Page 21\22

FRONT CASE ASSEMBLY
(2 OF 2)
ILLUSTRATED PARTS BREAKDOWN

Number	Description
1	Front Case Molding
2	Rotor Knob
3	Rotor Shaft
6	Probe Switch
8	NOMEX Insulator
9	Retaining Clip
12	Main PWA
13	SpO_2 PWA
14	LCD Assembly
17	Screws
21	Probe Switch Lever

Note: Only the parts included on the Reorder List are replaceable. The components named in the above illustration are for informational purposes only.

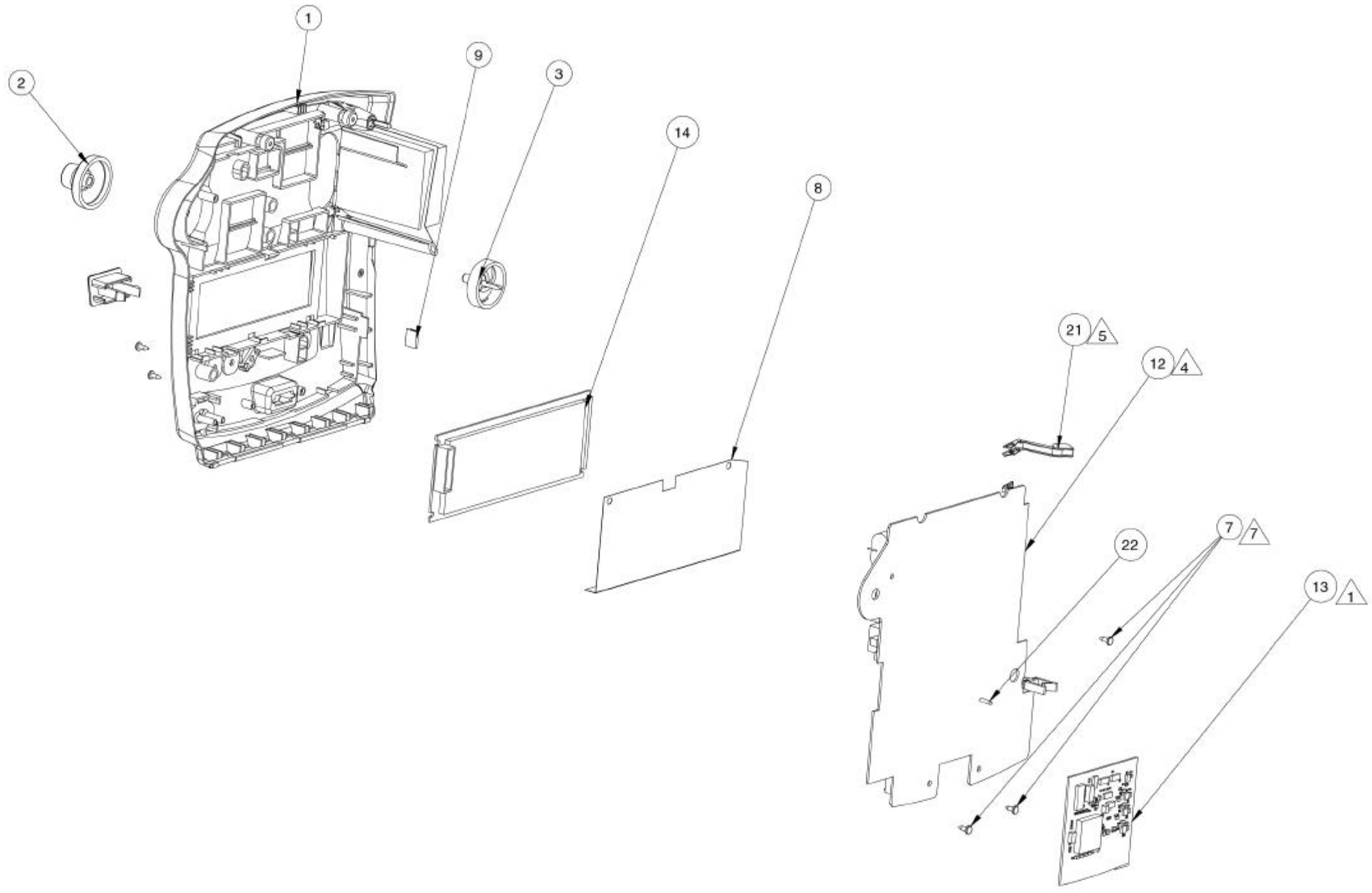
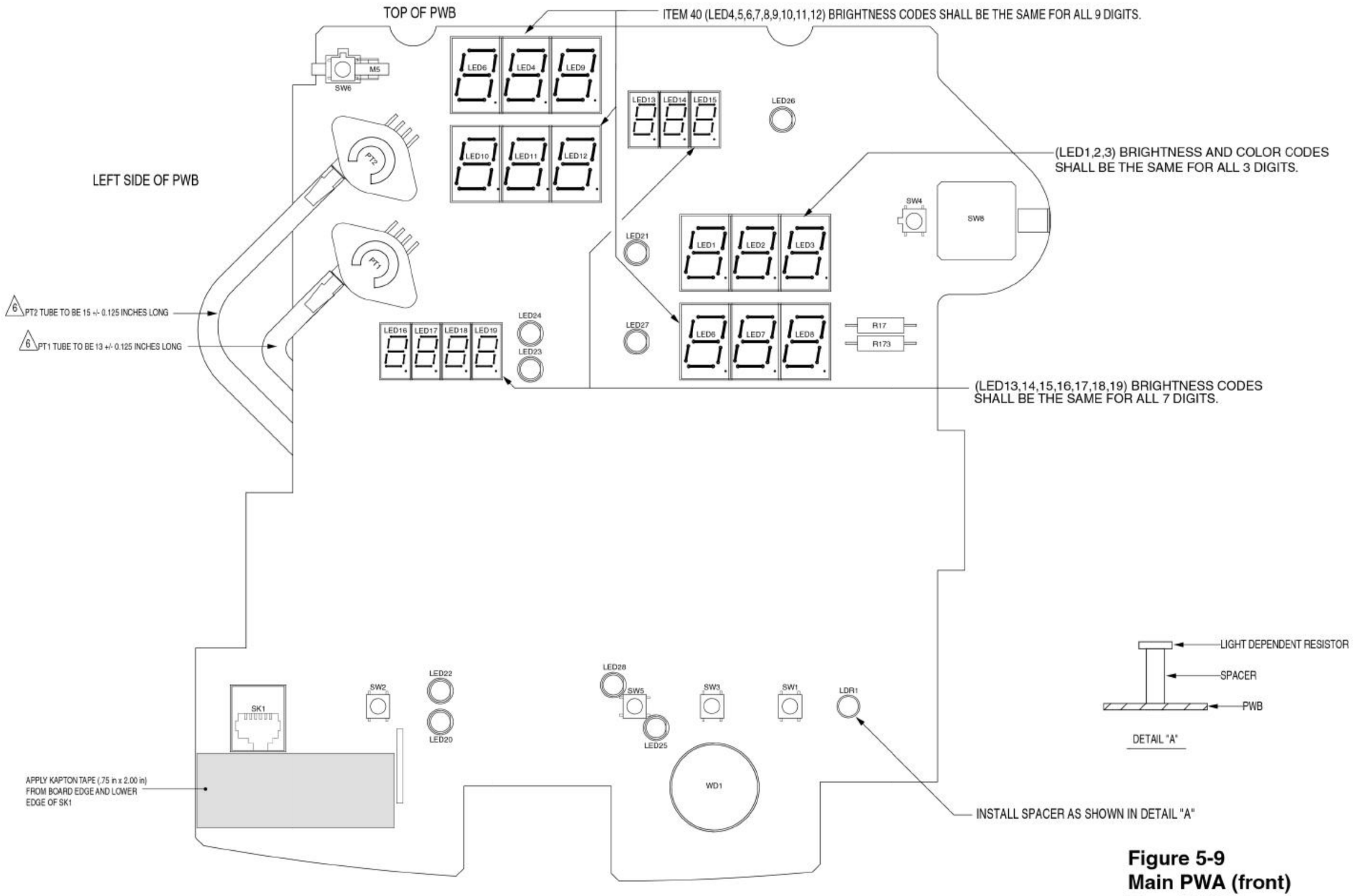


Figure 5-8
Front Case Assembly (2 of 2)
Page 25/26

MAIN PWA
(FRONT)
ILLUSTRATED PARTS BREAKDOWN

Note: Only the parts included on the Reorder List are replaceable. The components named in the above illustration are for informational purposes only.



COMPONENT VIEW

Figure 5-9
Main PWA (front)
Page 29/30

MAIN PWA
(BACK)
ILLUSTRATED PARTS BREAKDOWN

Note: Only the parts included on the Reorder List are replaceable. The components named in the above illustration are for informational purposes only.

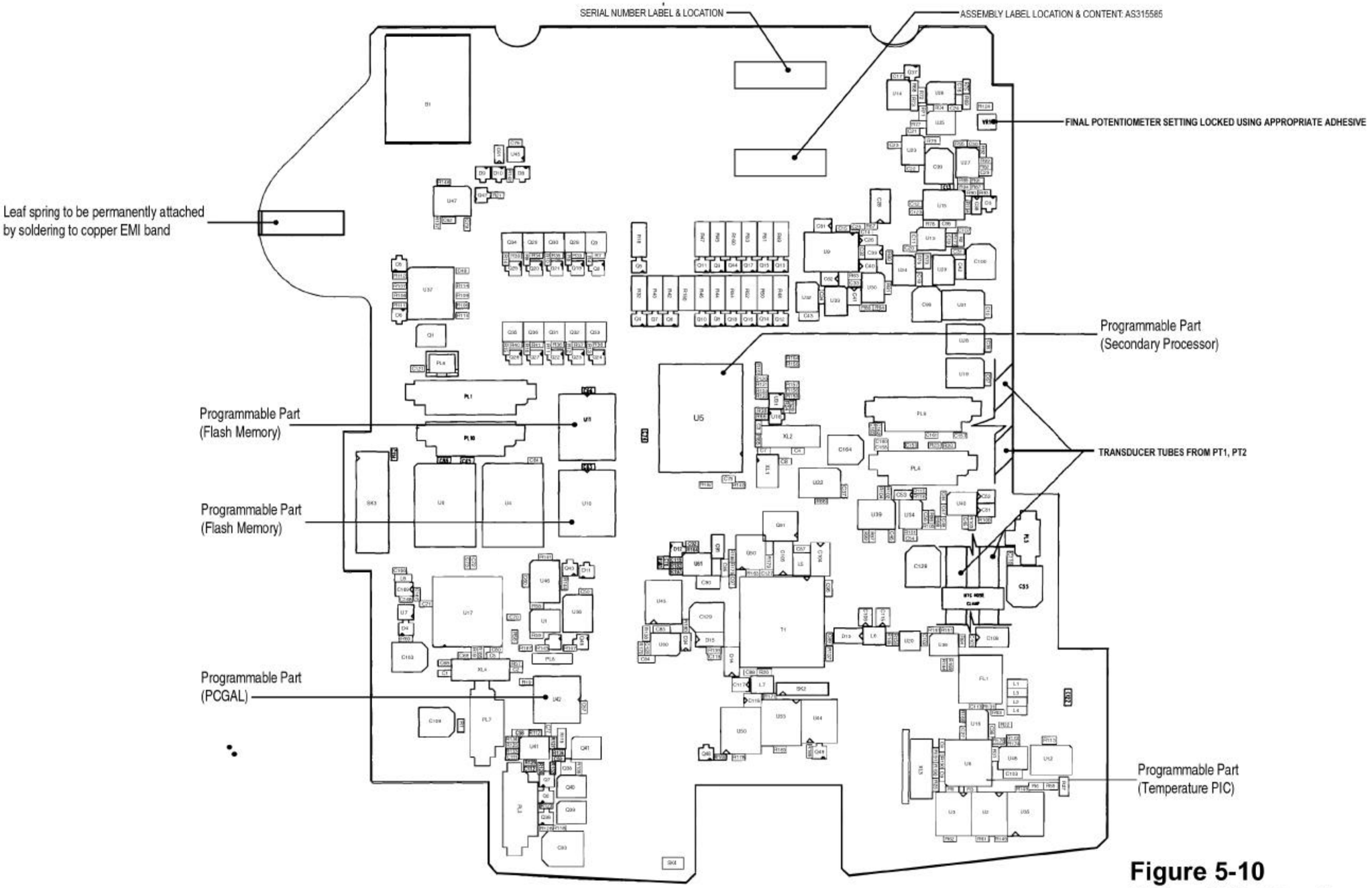
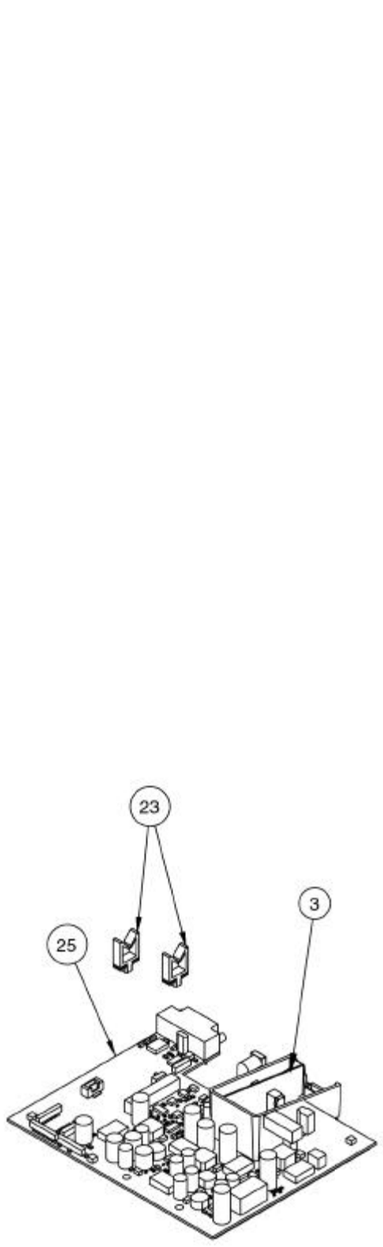

SERIAL NUMBER LABEL & LOCATION
ASSEMBLY LABEL LOCATION & CONTENT: AS315585
FINAL POTENTIOMETER SETTING LOCKED USING APPROPRIATE ADHESIVE
Leaf spring to be permanently attached by soldering to copper EMI band
Programmable Part (Secondary Processor)
Programmable Part (Flash Memory)
TRANSDUCER TUBES FROM PT1, PT2
Programmable Part (Flash Memory)
Programmable Part (PCGAL)
Programmable Part (Temperature PIC)

Figure 5-10
Main PWA (Back)
Page 33/34

REAR CASE ASSEMBLY
(1 OF 1)
ILLUSTRATED PARTS BREAKDOWN

Number	Description
1	Rear Case Assembly
2	Battery Door
3	Battery Support
4	Pole Clamp
5	Screw, Pole Clamp
6	Knob, Pole Clamp
8	Washer
9	Circlip
10	Screw
11	Washer
12	Screw
13	Foot, Round
14	Speaker Assembly
15	Speaker Clamp
16	Retaining Clip
17	PSU Module
18	Pneumatics Module
19	Bracket, Pump Assembly
21	Grommet
23	Fastener, Wire Assembly
24	AC Connector
25	PSU PWA
26	Plug, Ext. DC Jack
27	Tape, Foam

Note: Only the parts included on the Reorder List are replaceable. The components named in the above illustration are for informational purposes only.



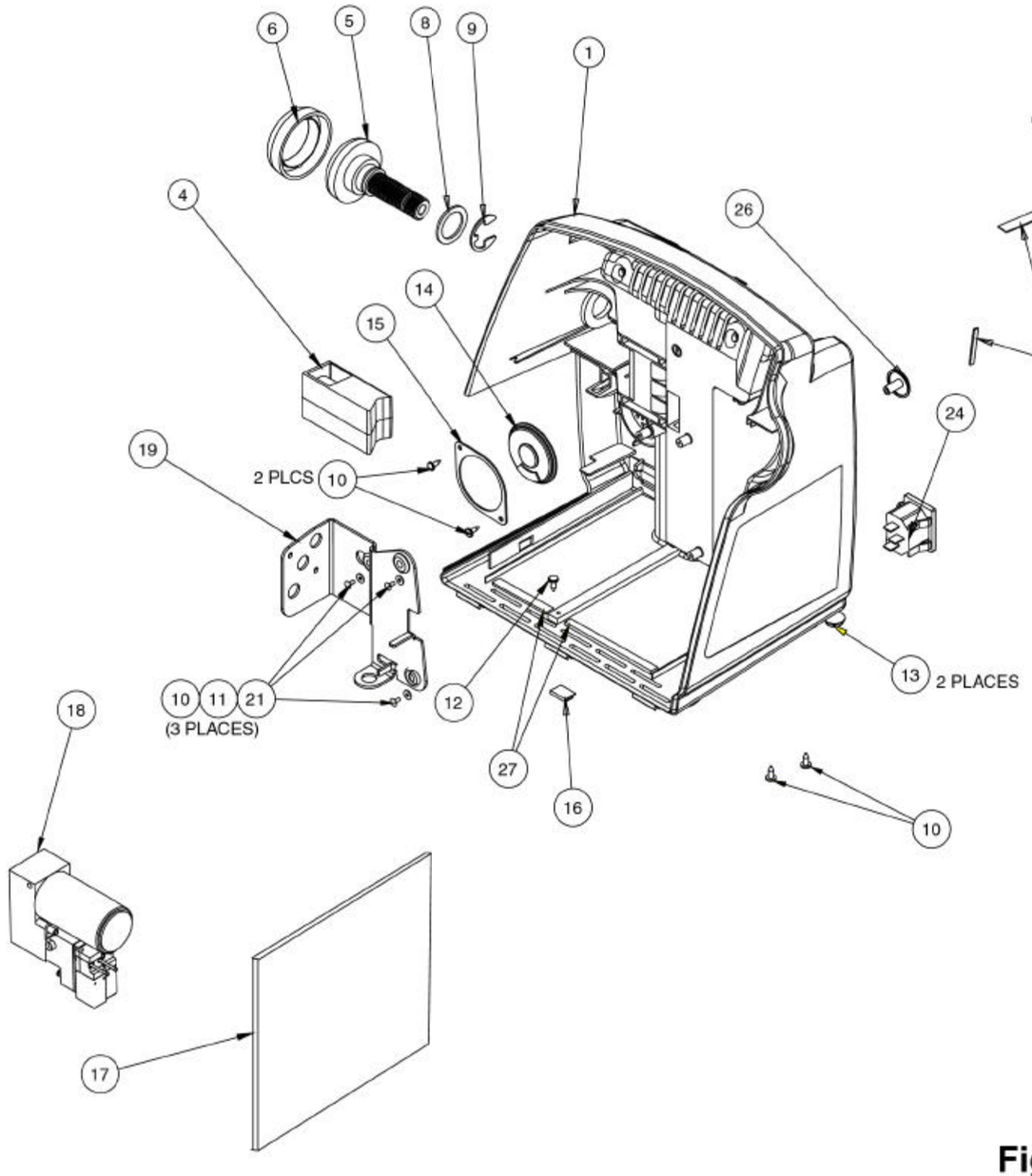


Figure 5-11
Rear Case Assembly
Page 37/38

PRINTER ASSEMBLY
(1 OF 1)
ILLUSTRATED PARTS BREAKDOWN

Number	Description
1	Thermal Printer
2	Printer Chassis (housing)
3	Printer Door
4	Latch
5	Printer Label
6	Printer Interface PWA
7	Paper Guide
9	Ferrite Bead
10	Label

Note: Only the parts included on the Reorder List are replaceable. The components named in the above illustration are for informational purposes only.

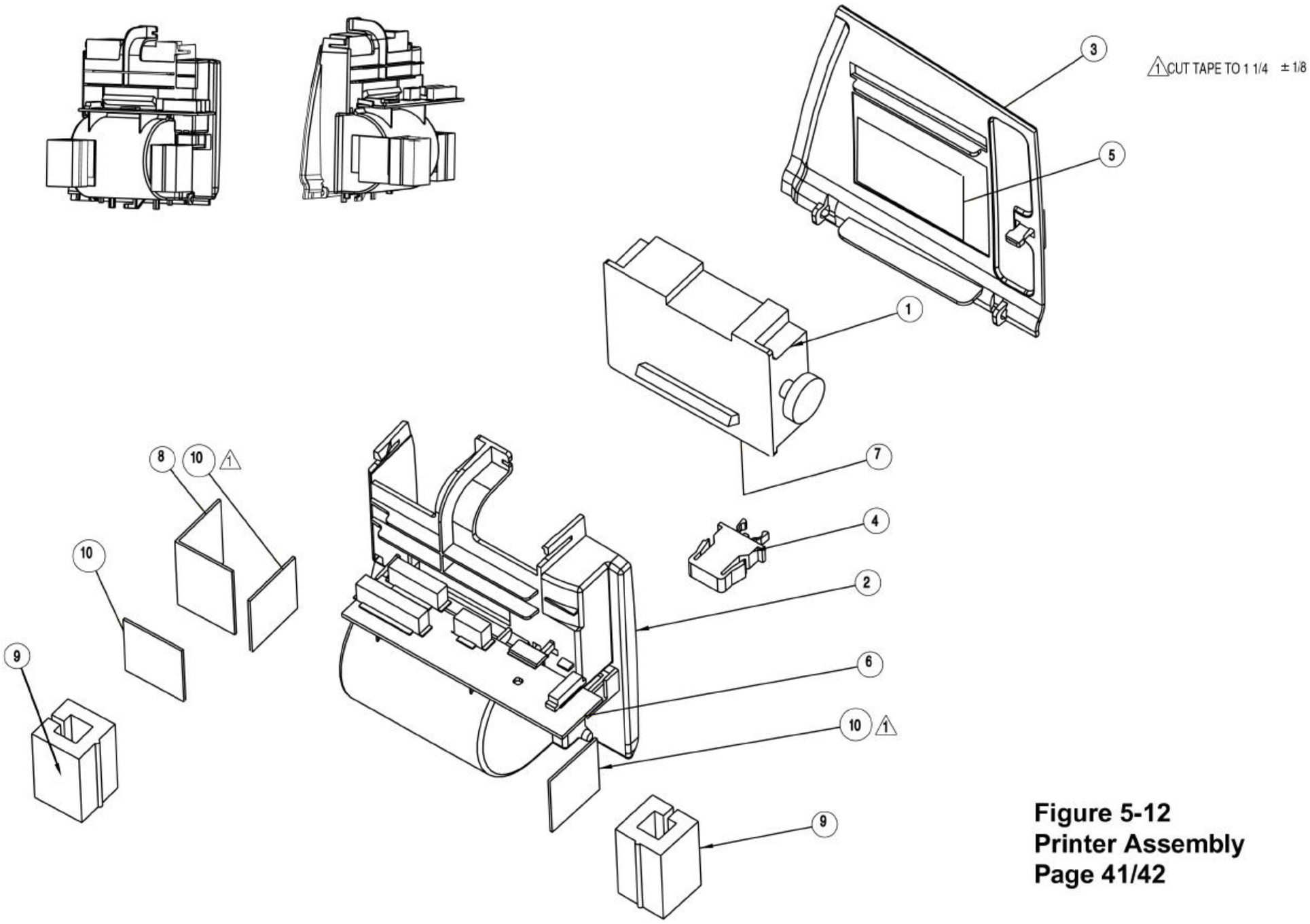
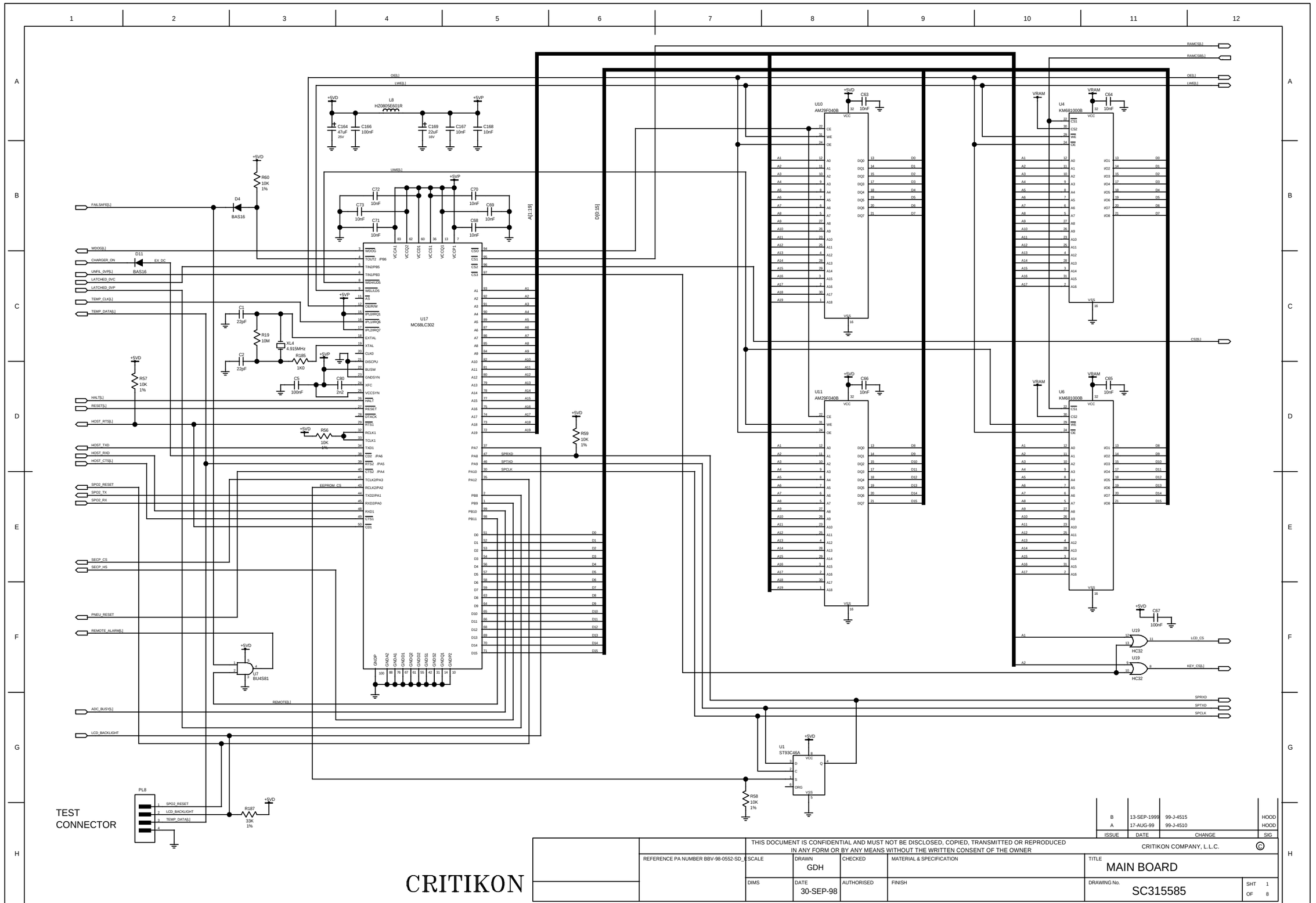


Figure 5-12
Printer Assembly
Page 41/42



ISSUE	DATE	CHANGE	SIG
B	13-SEP-1999	99-J-4515	HOOD
A	17-AUG-99	99-J-4510	HOOD

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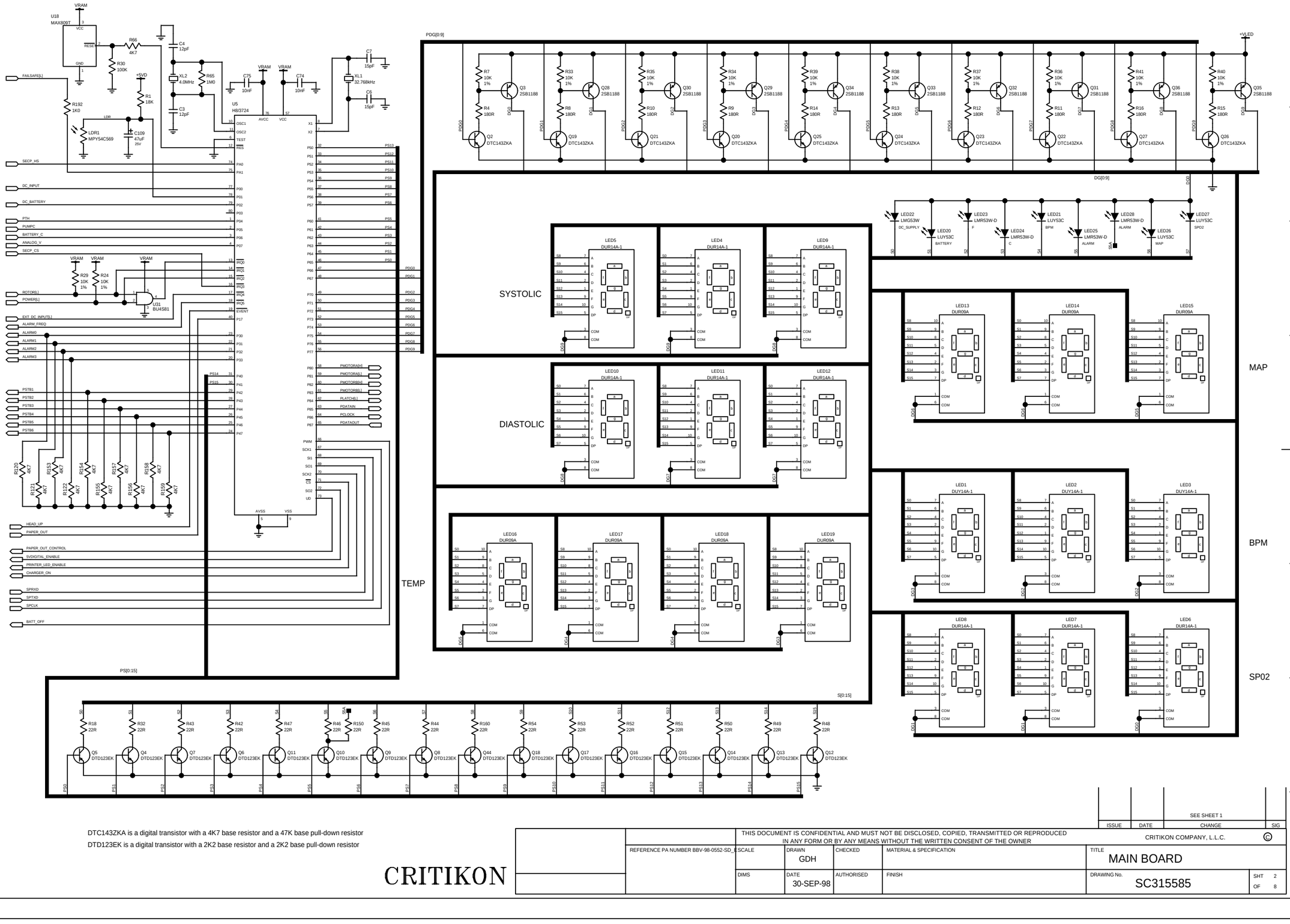
REFERENCE PA NUMBER BBV-98-0552-SD_E	SCALE	DRAWN	CHECKED	MATERIAL & SPECIFICATION	TITLE
		GDH			MAIN BOARD
	DIMS	DATE	AUTHORISED	FINISH	DRAWING No. SC315585
		30-SEP-98			SHT 1 OF 8



DTC143ZKA is a digital transistor with a 4K7 base resistor and a 47K base pull-down resistor
DTD123EK is a digital transistor with a 2K2 base resistor and a 2K2 base pull-down resistor

ISSUE	DATE	CHANGE	SIG
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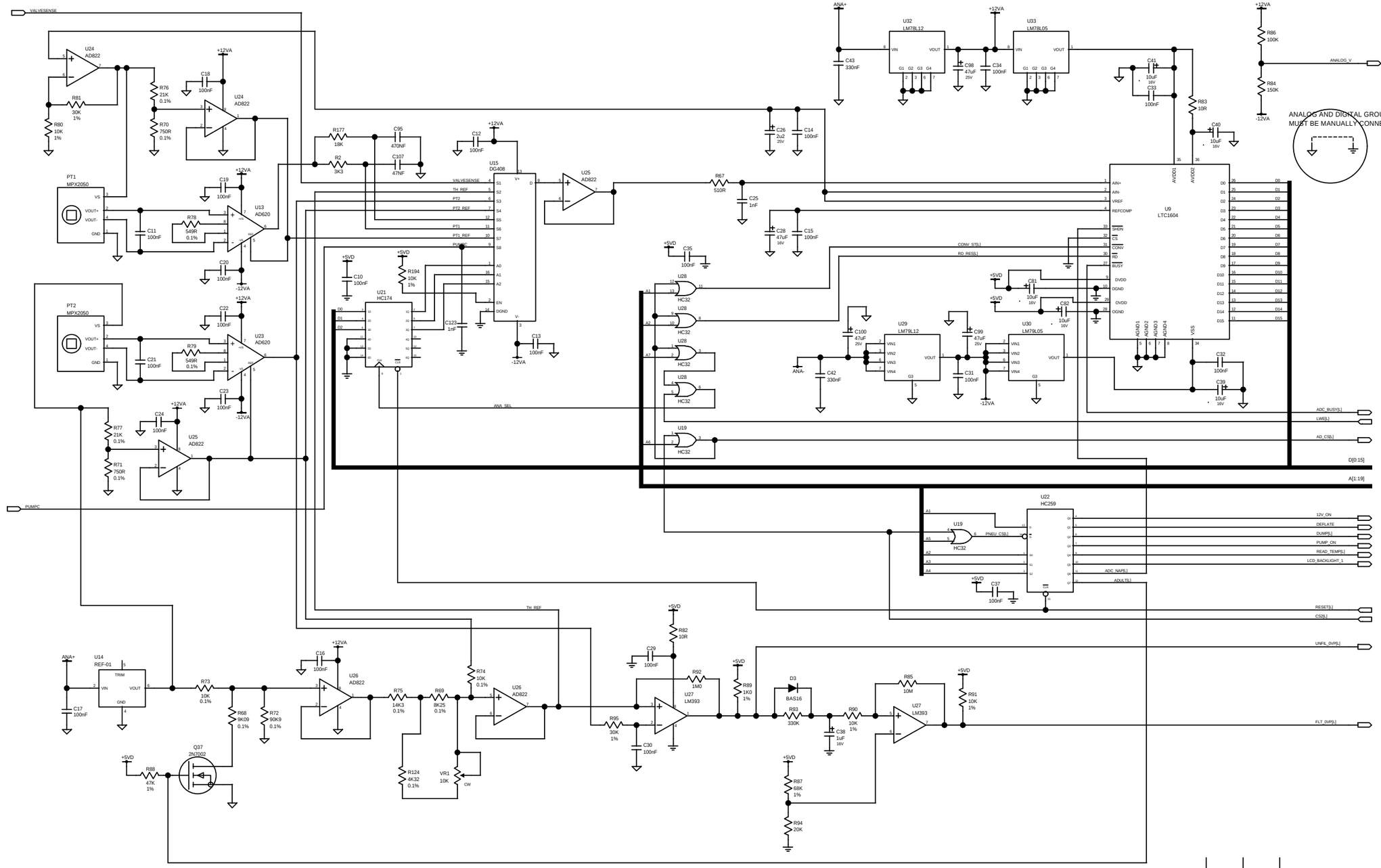
		30-SEP-98			SC315585 / 2 / 8



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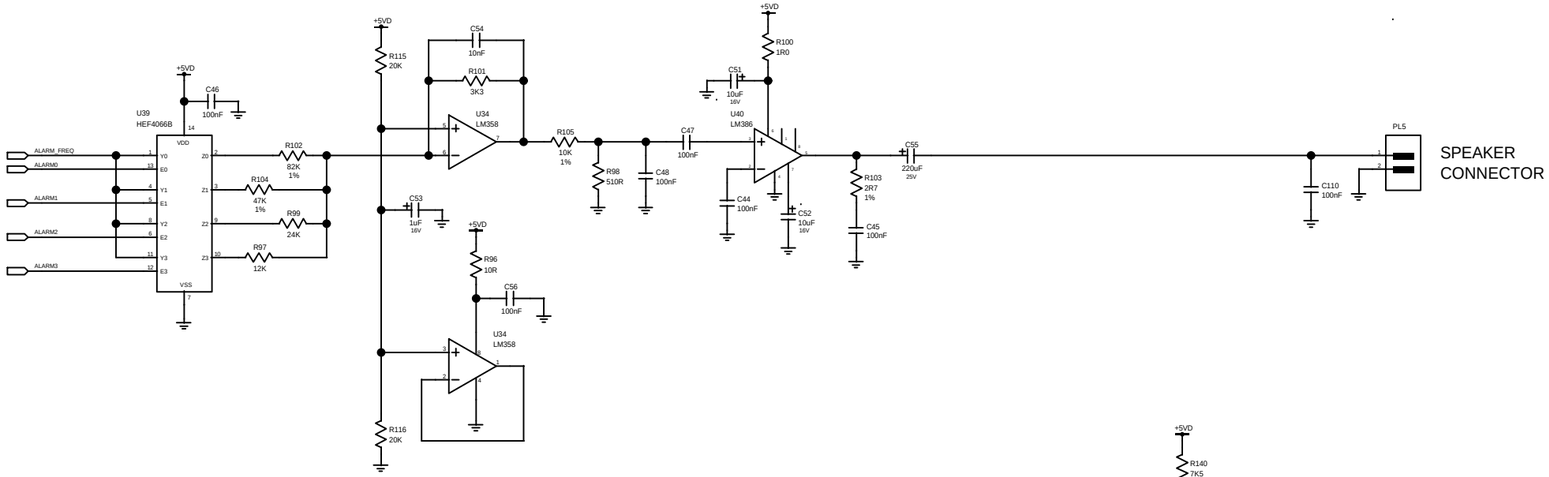
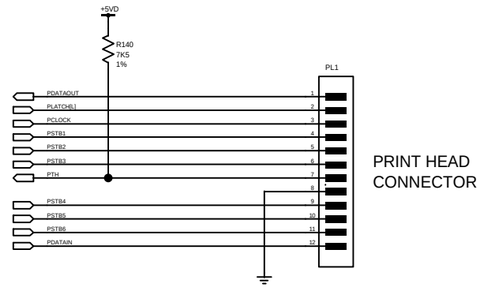
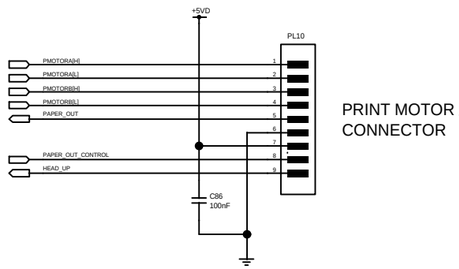
	DIMS	DATE 30-SEP-98	AUTHORISED	FINISH	DRAWING No. SC315585 SHT 3 OF 8







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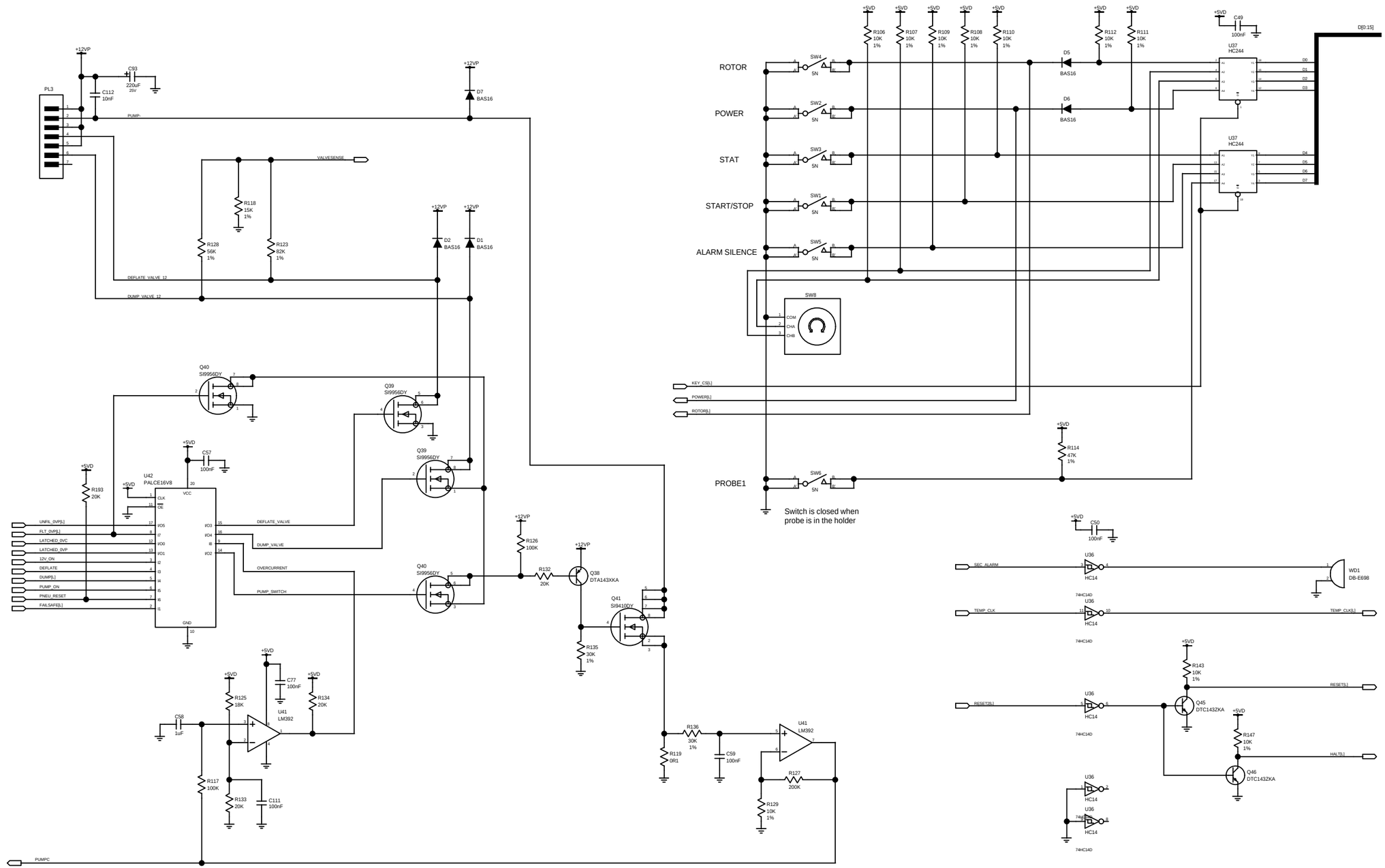
	DIMS	DATE 30-SEP-98	AUTHORISED	FINISH	DRAWING No. SC315585

SHT 4
OF 8



DTA143XKA is a digital transistor with a 4K7 base resistor and a 10K base pull-down resistor

DTC143ZKA is a digital transistor with a 4K7 base resistor and a 47K base pull-down resistor

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SHT 5
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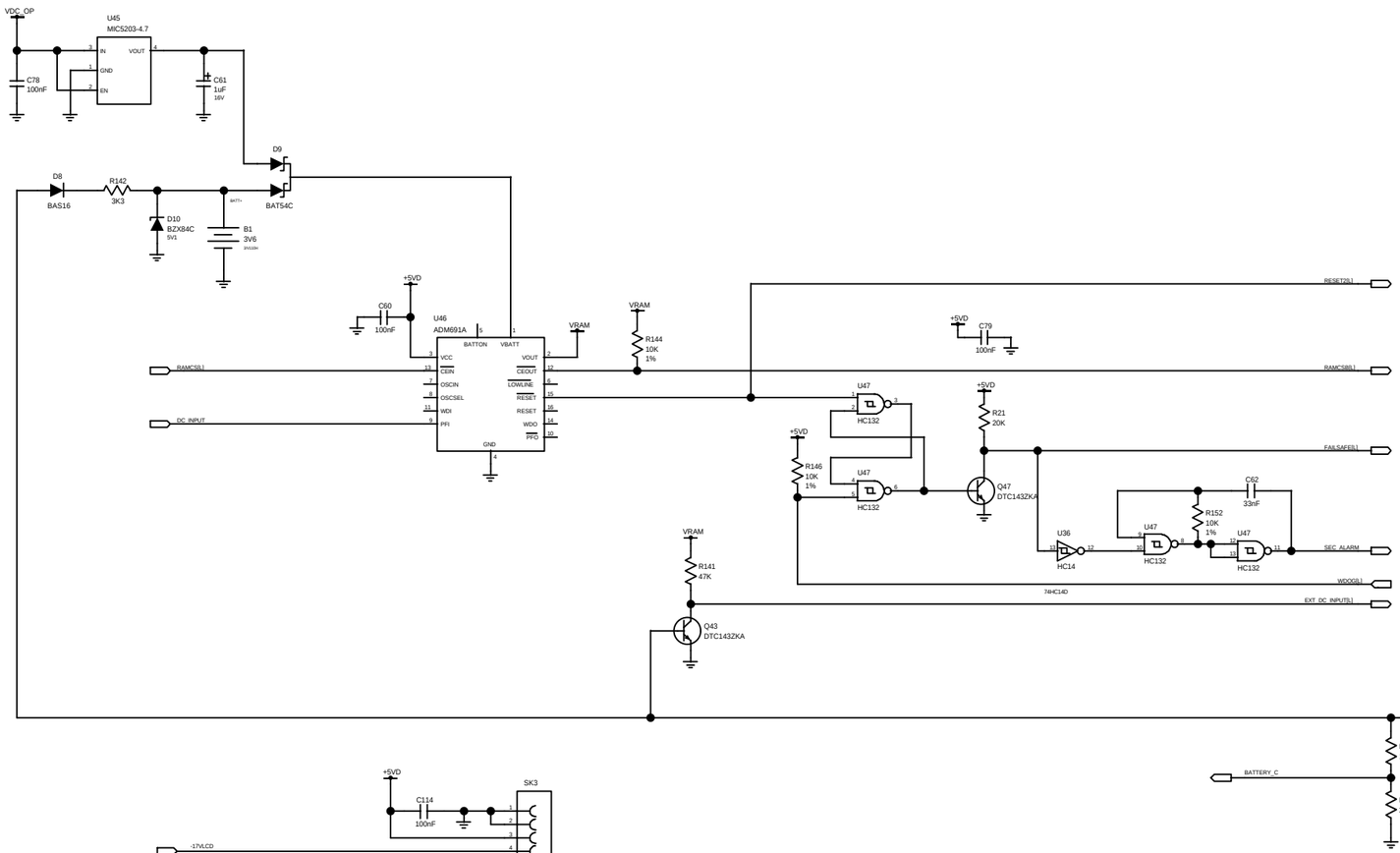

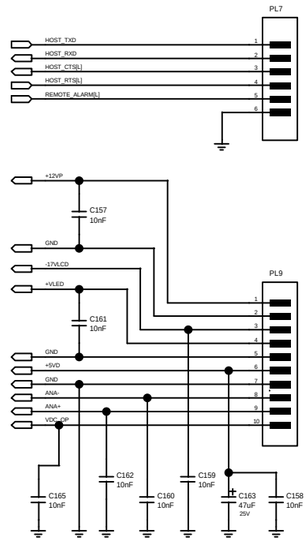

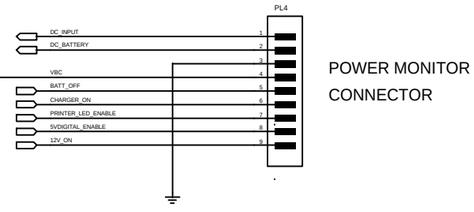

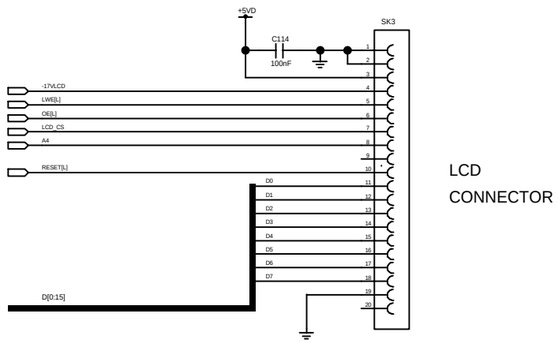

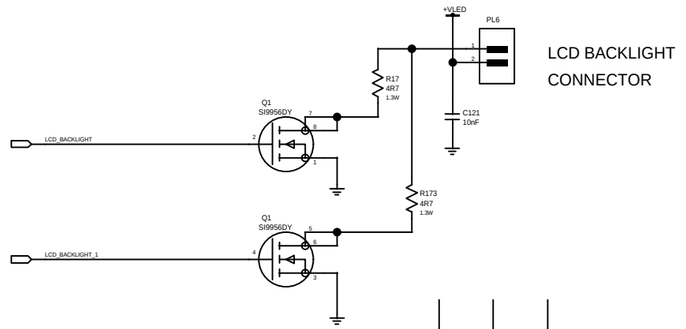

DTC143ZKA is a digital transistor with a 4K7 base resistor and a 47K base pull-down resistor

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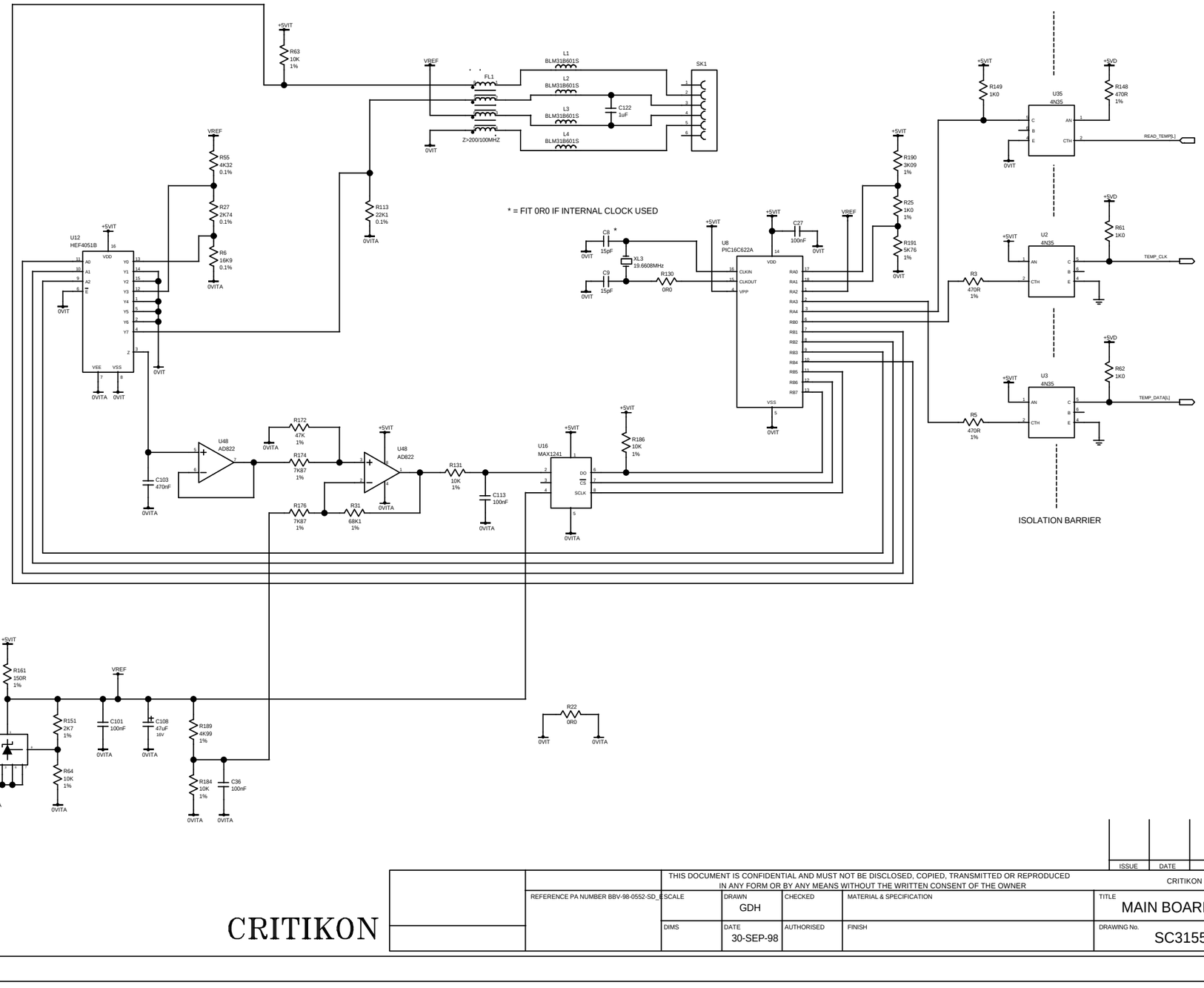

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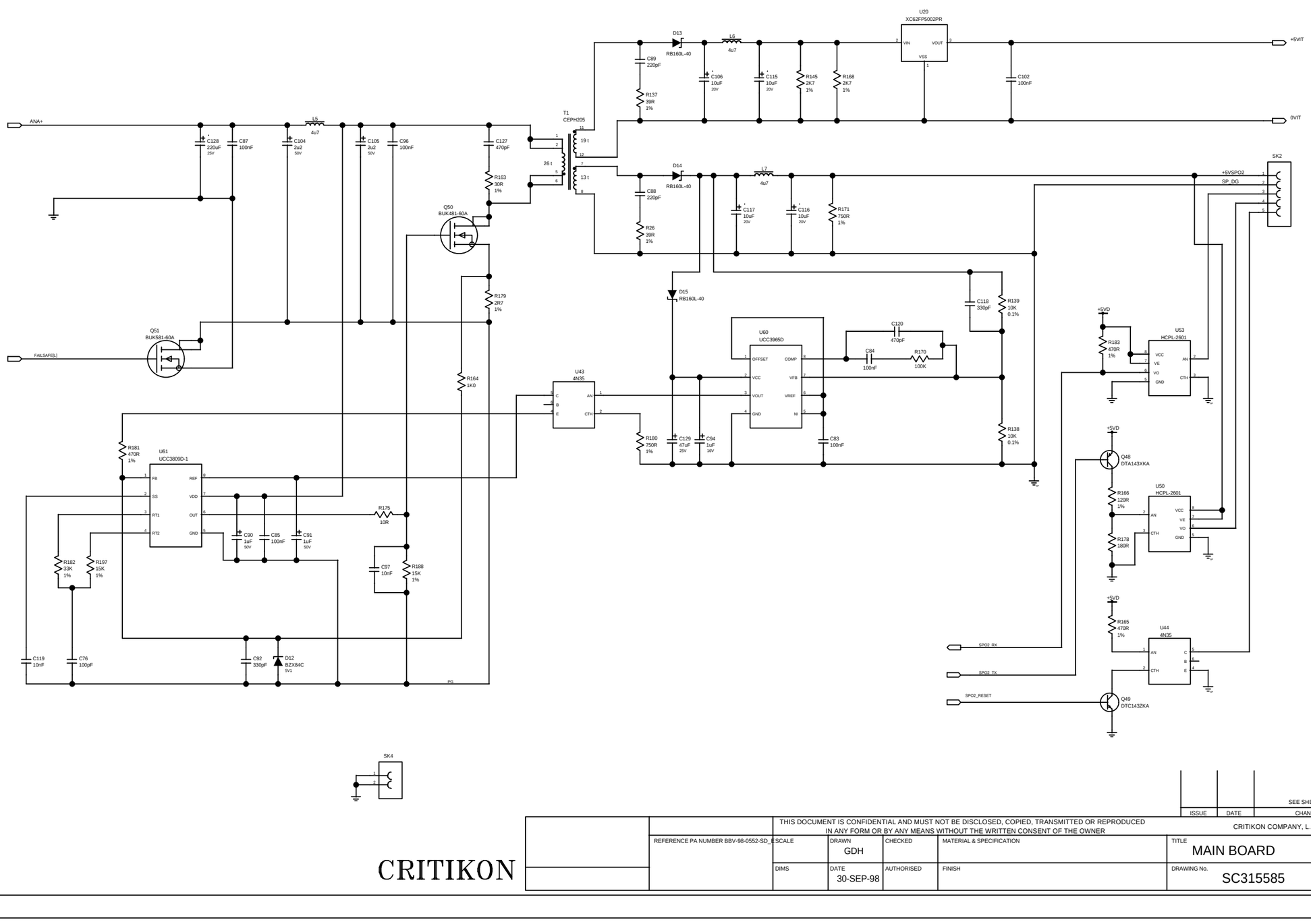

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REFERENCE PA NUMBER BBV-98-0552-SD_E

ESCALE	DRAWN	CHECKED	MATERIAL & SPECIFICATION	TITLE	
	GDH			MAIN BOARD	
DIMS	DATE	AUTHORISED	FINISH	DRAWING No.	SHT 8 OF 8
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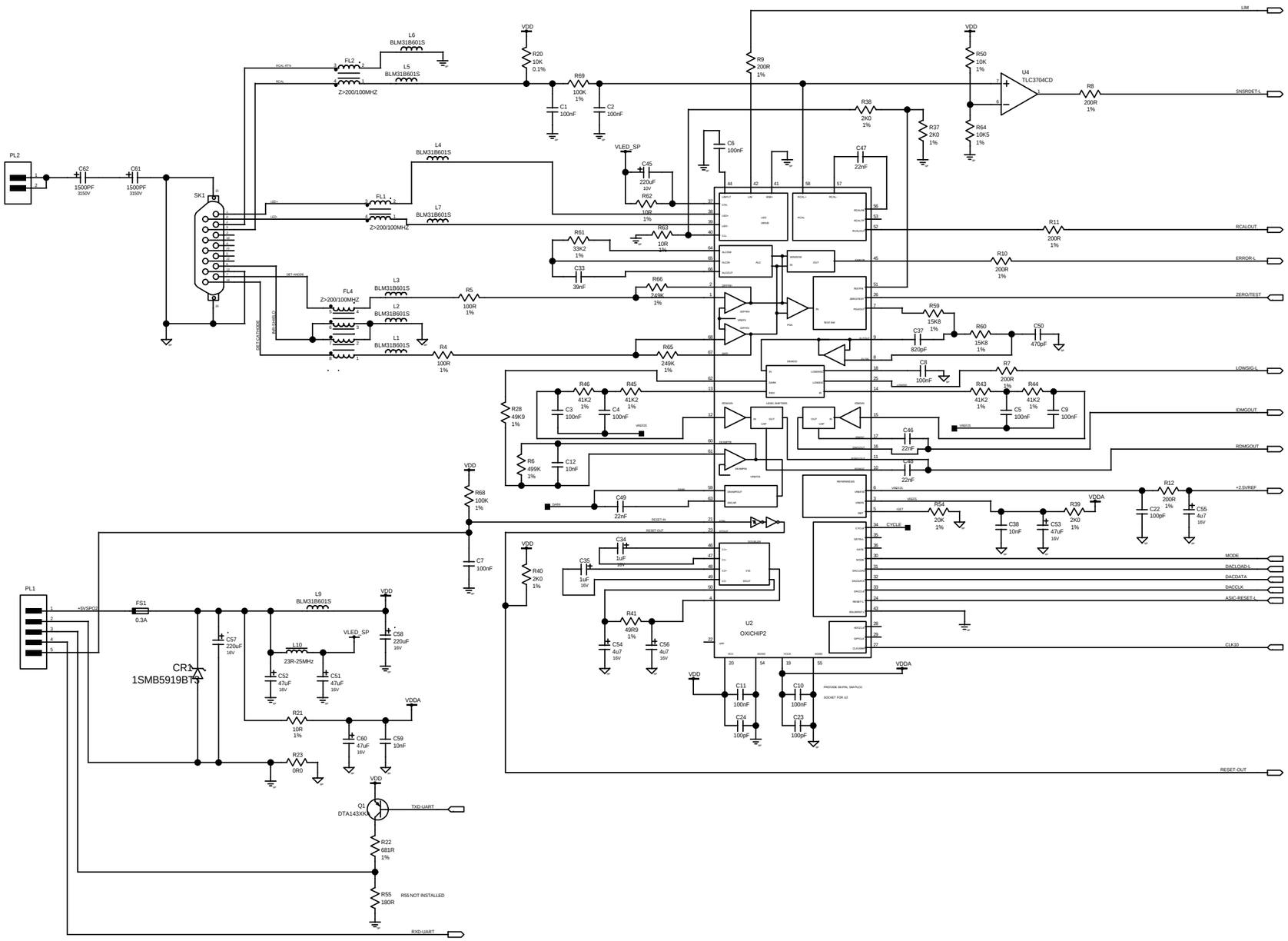

ISSUE	DATE	CHANGE	SIG
A	17-AUG-99	99-J-4510	HOOD

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REF PA PART NUMBER BBV-98-1011-SD_B	SCALE	DRAWN	CHECKED	MATERIAL & SPECIFICATION	TITLE
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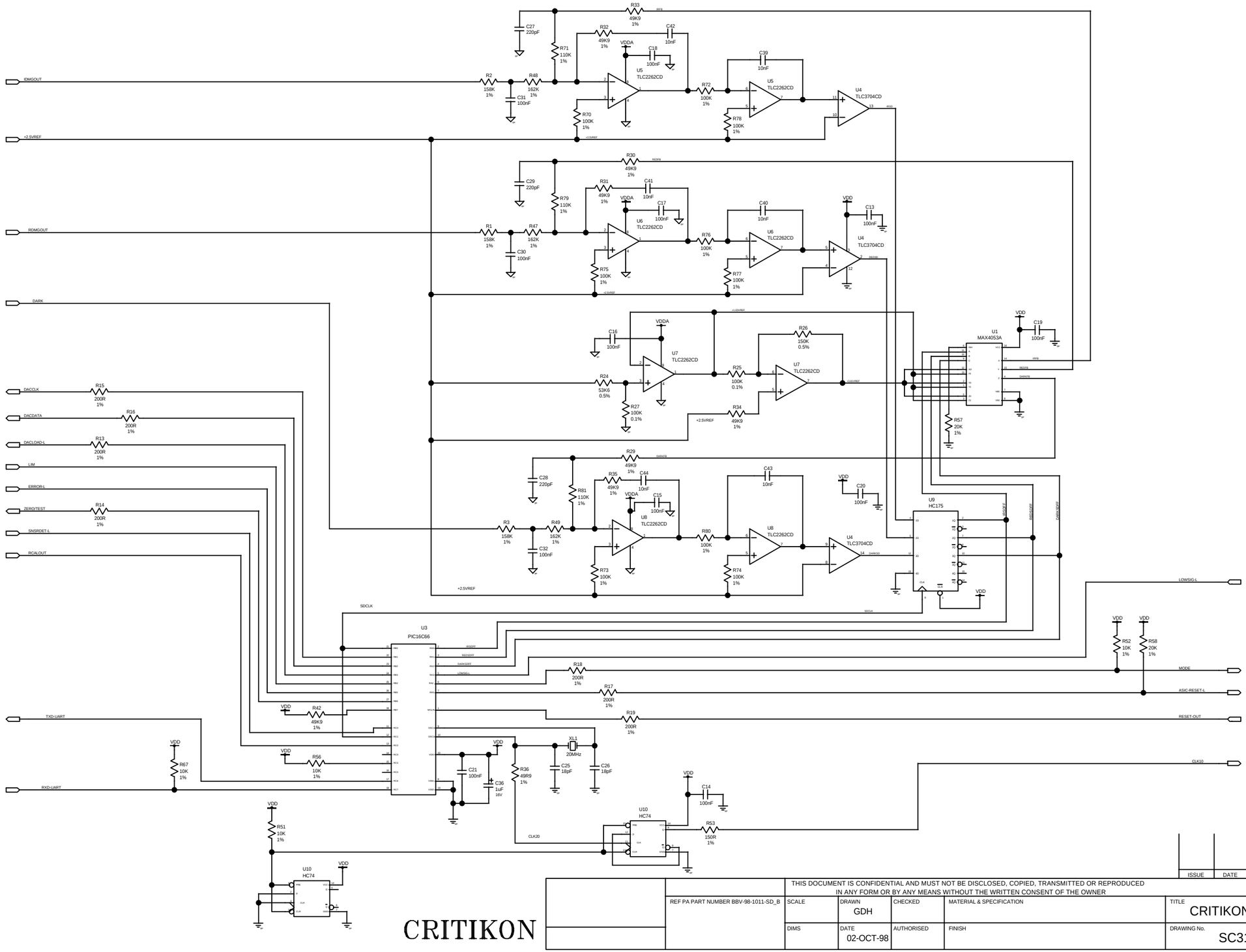
	DIMS	DATE	AUTHORISED	FINISH	DRAWING No. / SHT / OF
		02-OCT-98			SC315584 / 1 / 2



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					SEE SHEET 1	
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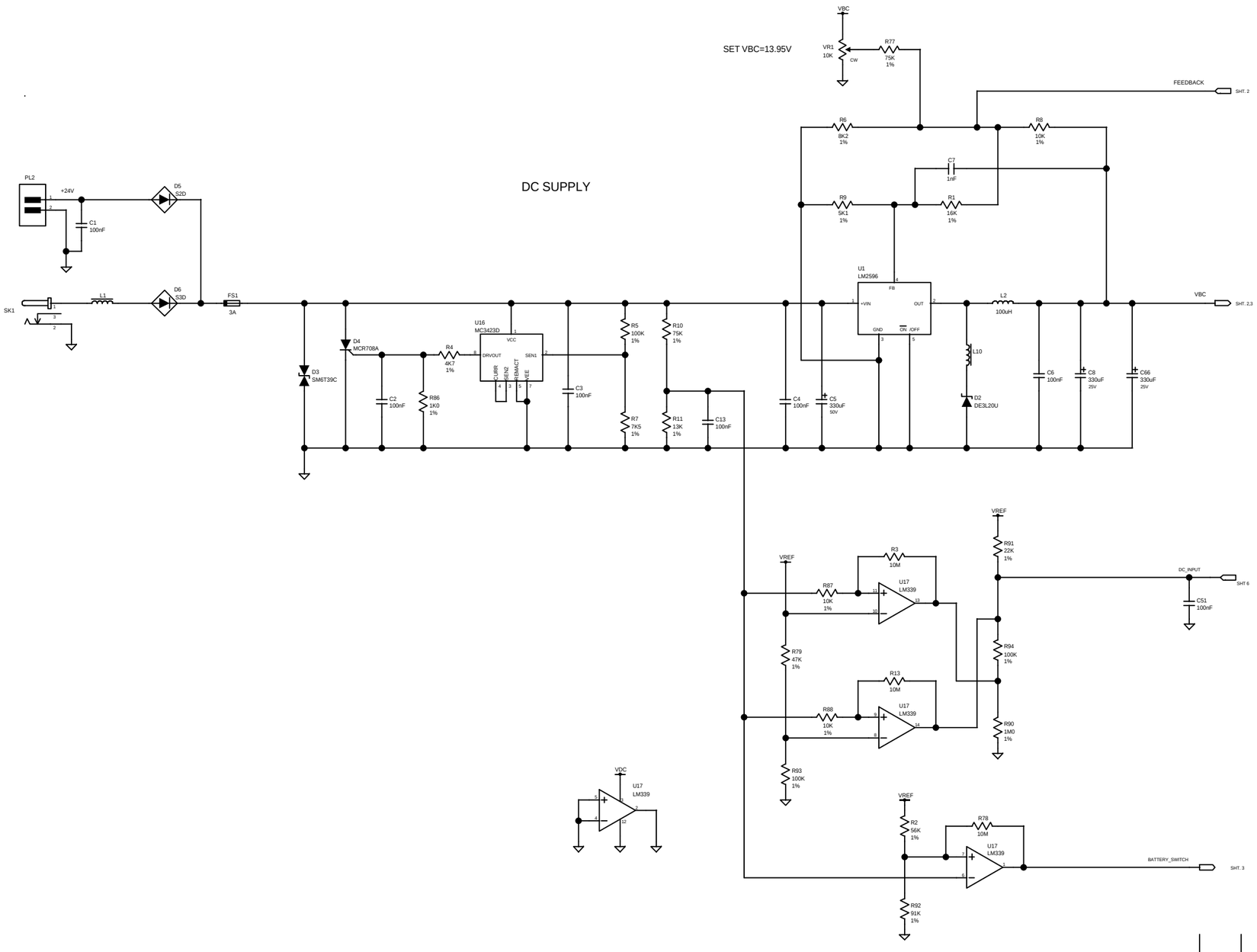
REF PA PART NUMBER BBV-98-1011-SD_B		SCALE	DRAWN GDH	CHECKED	MATERIAL & SPECIFICATION	TITLE CRITIKON - SPO2
		DIMS	DATE 02-OCT-98	AUTHORISED	FINISH	DRAWING No. SC315584 SHT 2 OF 2

DC SUPPLY

MAINS AC/DC MODULE
24V DC

EXTERNAL DC
12V - 32V

SET VBC=13.95V



ISSUE	DATE	CHANGE	SIG
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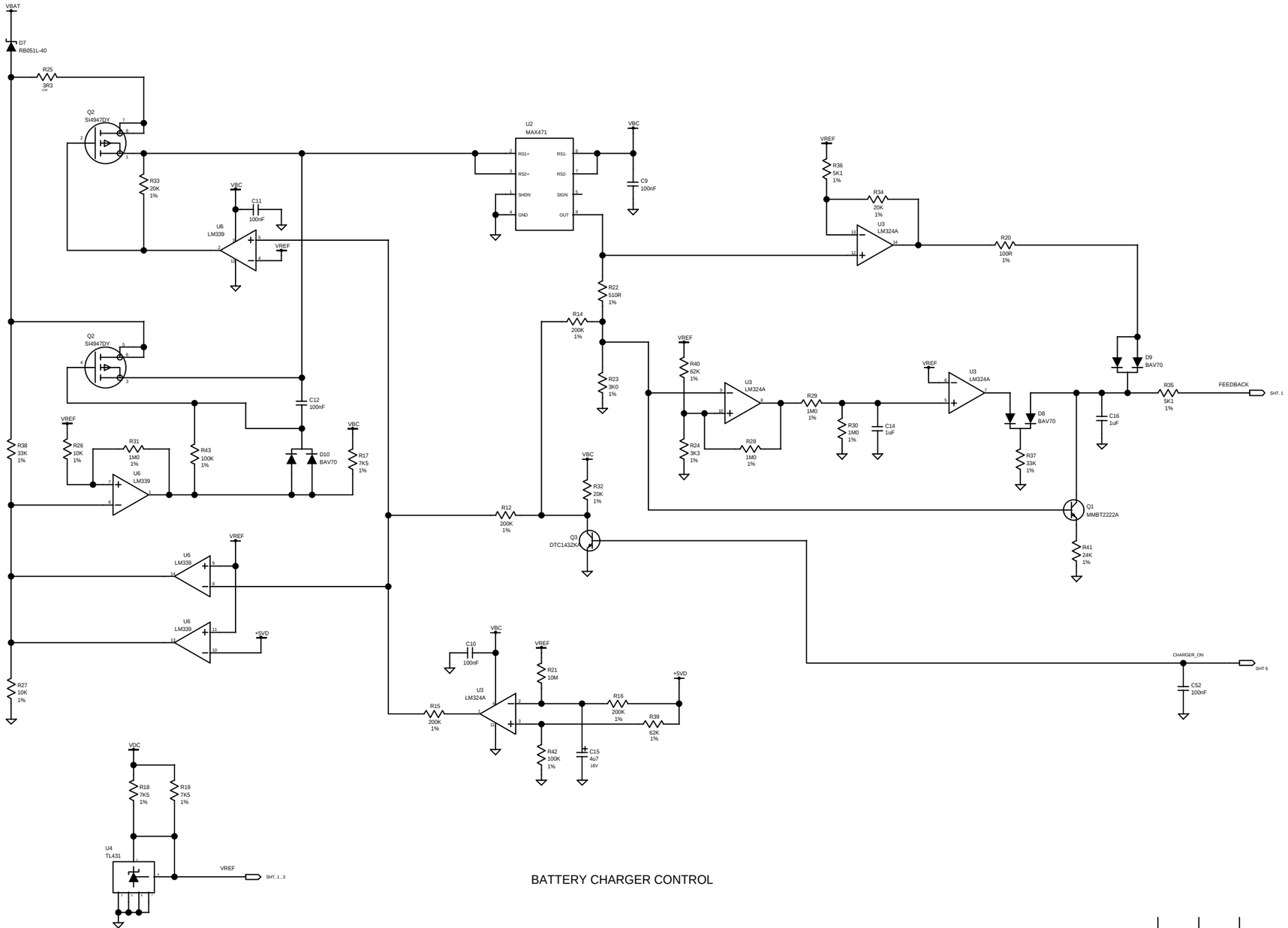
REFERENCE PA PART NUMBER BBV-98-1335-SD_C	SCALE	DRAWN GDH	CHECKED	MATERIAL & SPECIFICATION	TITLE CRITIKON - PSU
	DIMS	DATE 30-OCT-98	AUTHORISED	FINISH	DRAWING No. SC315588 SHT 1 OF 6



BATTERY CHARGER CONTROL

ISSUE	DATE	CHANGE	SIG
		SEE SHEET 1	

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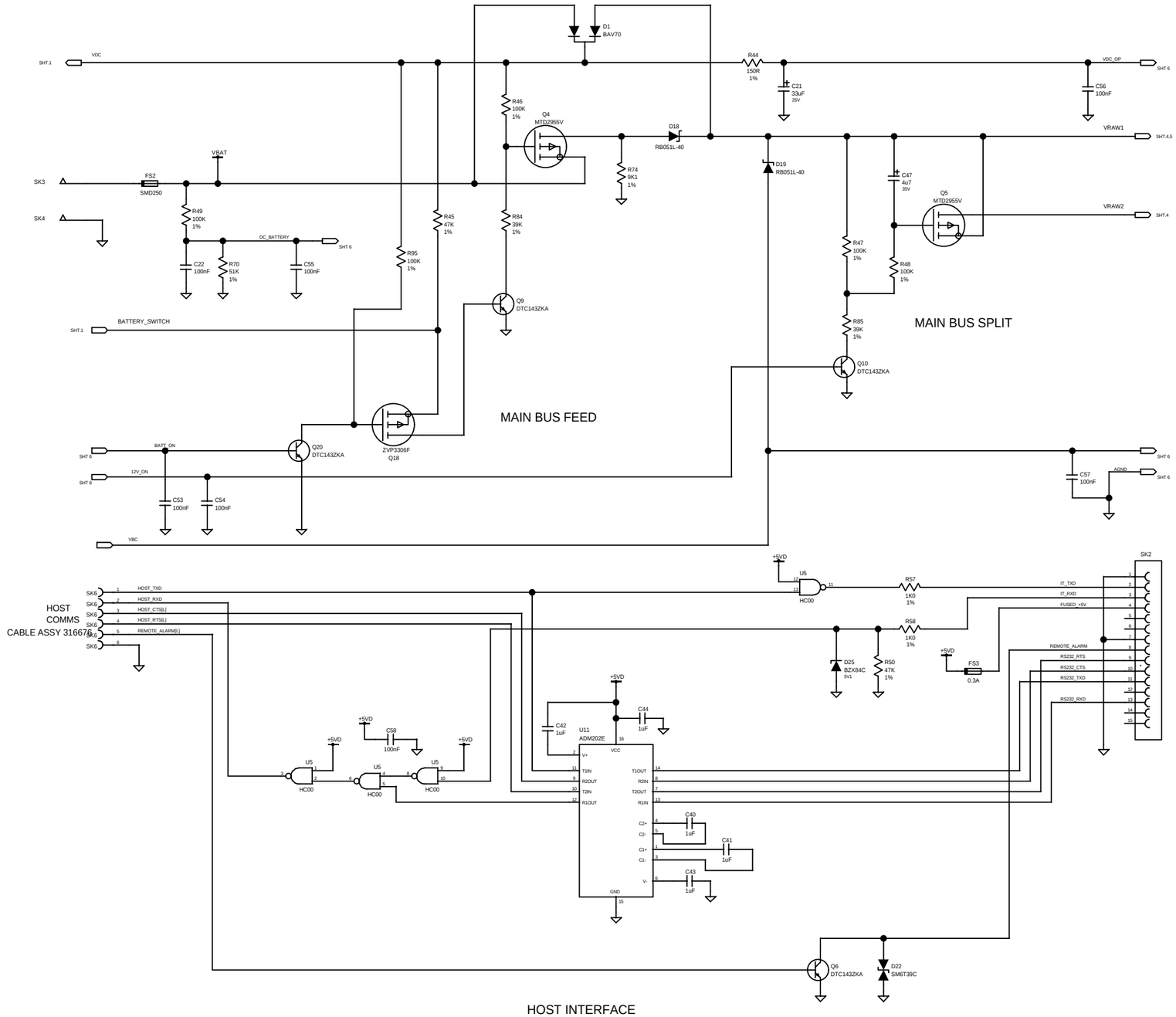
CRITIKON

REFERENCE PA PART NUMBER BBV-98-1335-SD_C

SCALE	DRAWN	CHECKED	MATERIAL & SPECIFICATION	TITLE
	GDH			CRITIKON - PSU
DIMS	DATE	AUTHORISED	FINISH	DRAWING No. / SHT / OF
	30-OCT-98			SC315588 / 2 / 6



ISSUE	DATE	CHANGE	SIG
		SEE SHEET 1	

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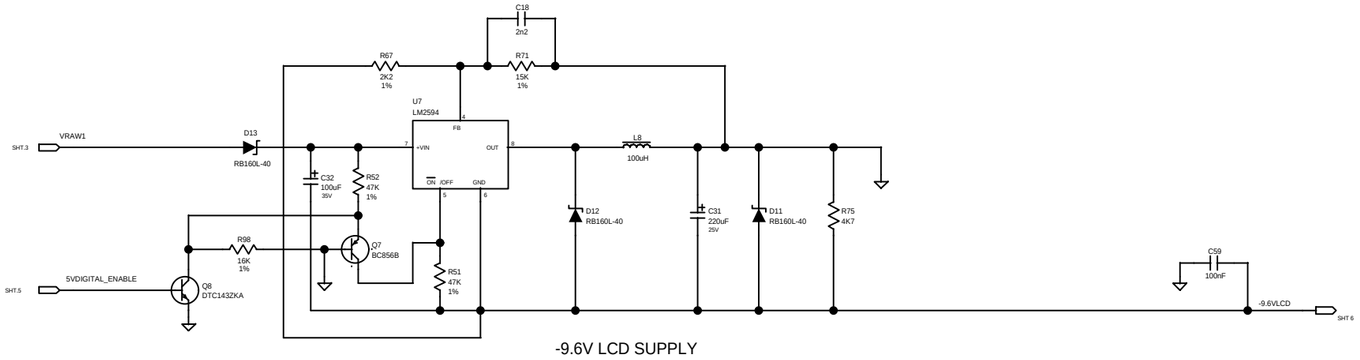
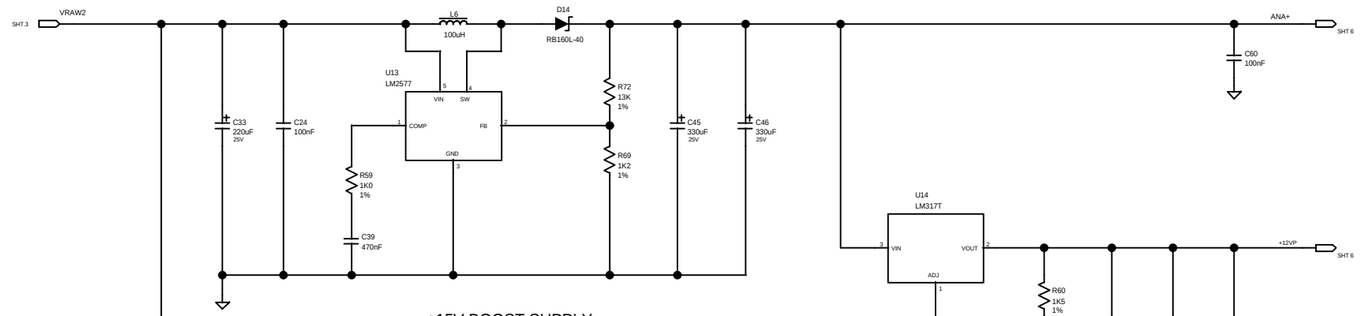
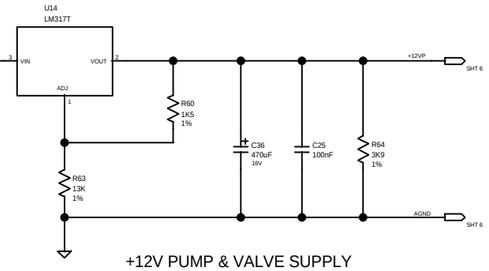
SCALE	DRAWN	CHECKED	MATERIAL & SPECIFICATION	TITLE
	GDH			CRITIKON - PSU
DIMS	DATE	AUTHORISED	FINISH	DRAWING No. / SHT / OF
	30-OCT-98			SC315588 / 3 / 6



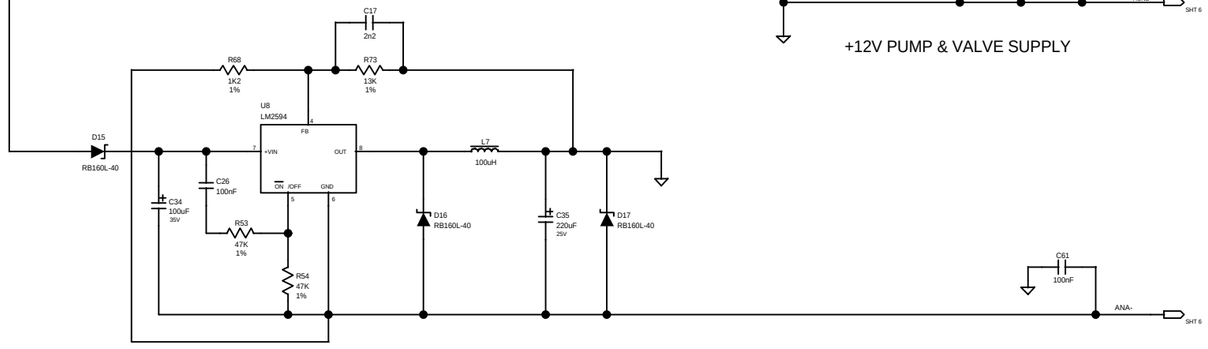
-9.6V LCD SUPPLY



+15V BOOST SUPPLY



+12V PUMP & VALVE SUPPLY



-14.5V ANA- SUPPLY

ISSUE	DATE	CHANGE	SIG
		SEE SHEET 1	

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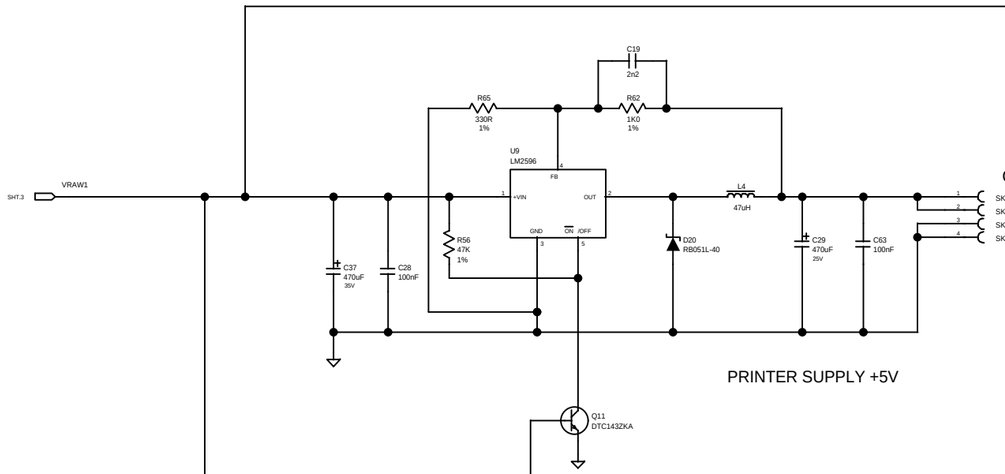
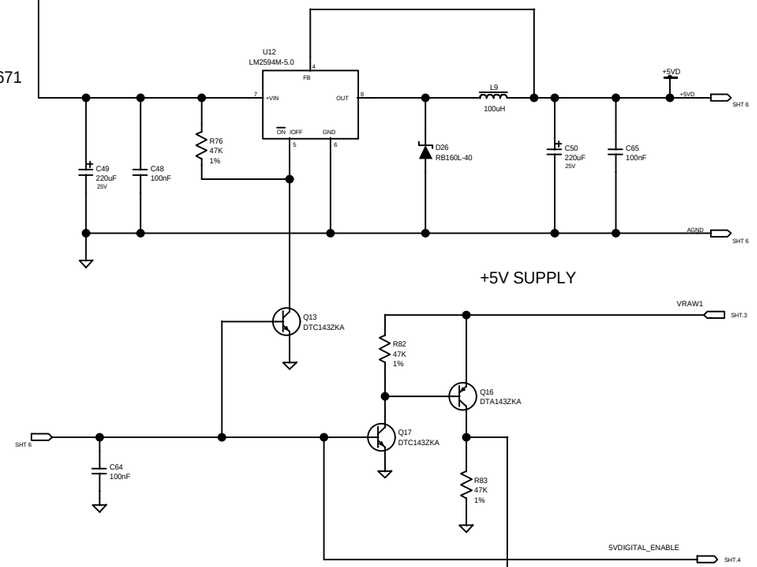
SD_C	GDH			CRITIKON - PSU
DIMS	DATE	AUTHORISED	FINISH	DRAWING No. / SHT / OF
	30-OCT-98			SC315588 / 4 / 6

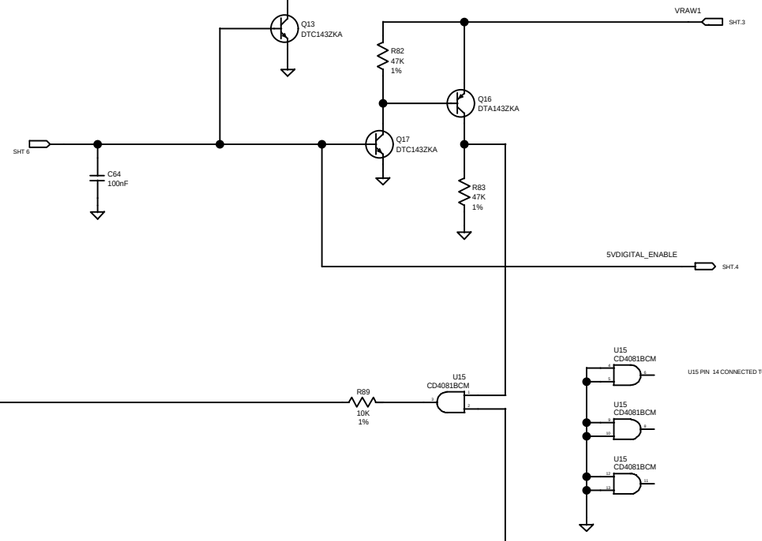
CABLE ASSY 316671

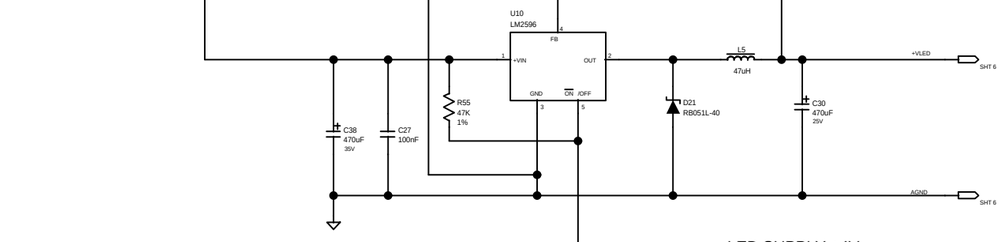


PRINTER SUPPLY +5V

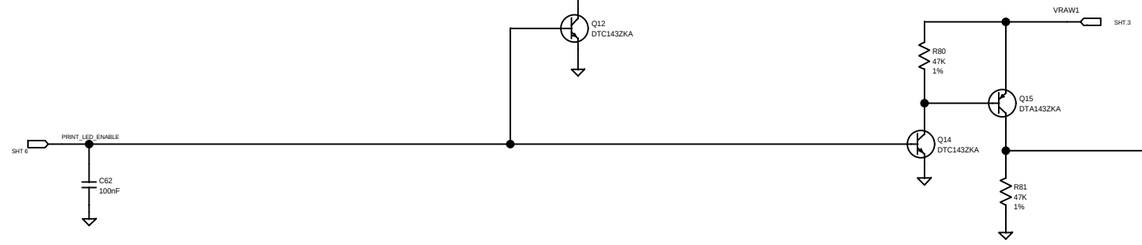


+5V SUPPLY





LED SUPPLY +4V



SEE SHEET 1

ISSUE	DATE	CHANGE	SIG

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CRITIKON

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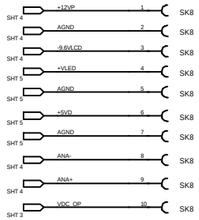
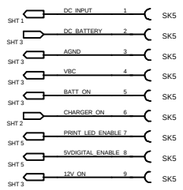
SCALE	DRAWN	CHECKED	MATERIAL & SPECIFICATION	TITLE
	GDH			CRITIKON - PSU
DIMS	DATE	AUTHORISED	FINISH	DRAWING No.
	30-OCT-98			SC315588

SHT 5
OF 6



CABLE ASSY 316674



CABLE ASSY 316675

ISSUE	DATE	CHANGE	SIG
		SEE SHEET 1	

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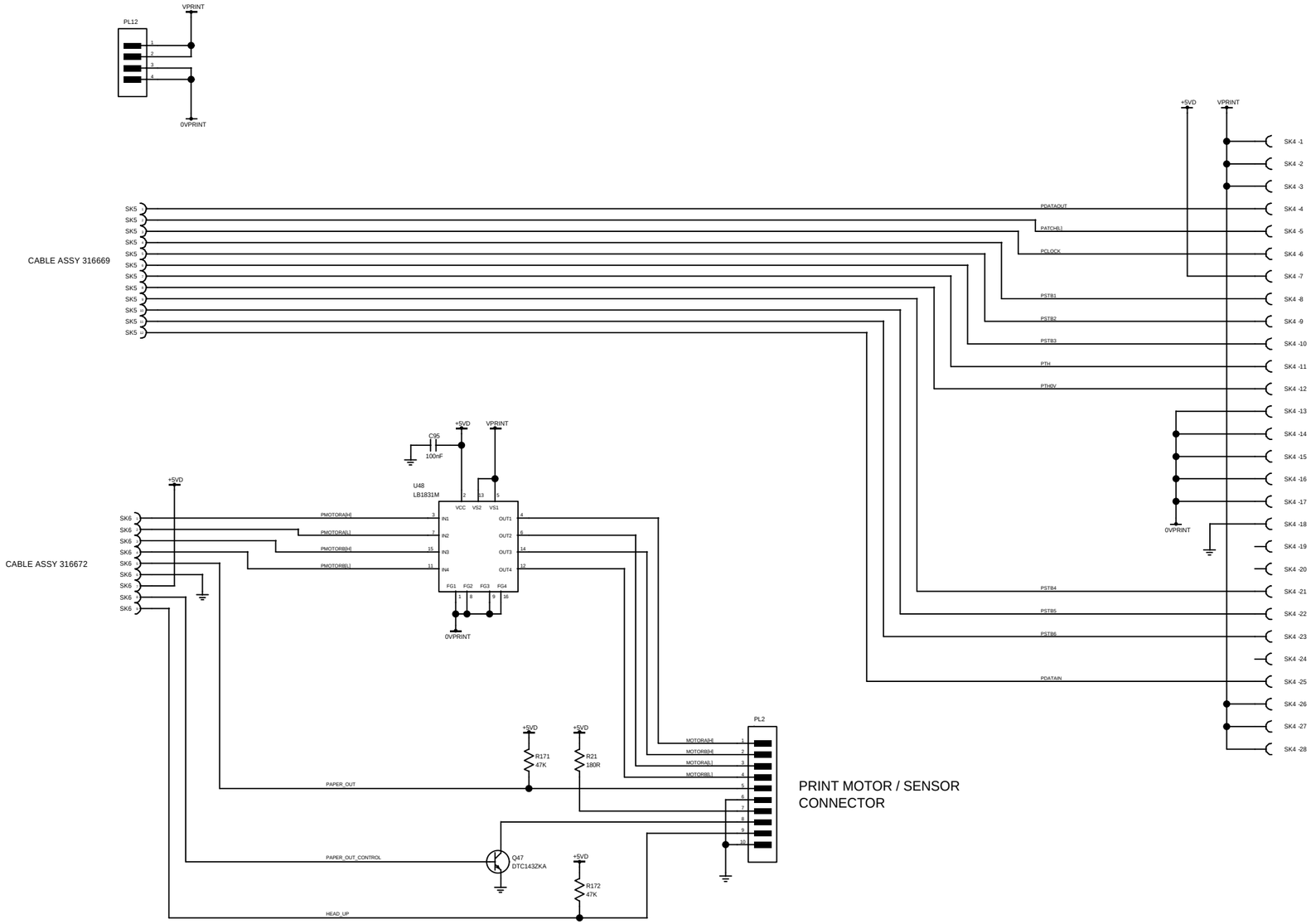
REFERENCE PA PART NUMBER BBV-98-1335-SD_C

SCALE	DRAWN	CHECKED	MATERIAL & SPECIFICATION	TITLE
	GDH			CRITIKON - PSU
DIMS	DATE	AUTHORISED	FINISH	DRAWING No. / SHT / OF
	30-OCT-98			SC315588 / 6 / 6



PRINT MOTOR / SENSOR CONNECTOR

ISSUE	DATE	CHANGE	SIG
A	17-AUG-99	99-J-4510	HOOD

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CRITIKON

REFERENCE PA PART MUMBER BBV-98-1308-SD_C

SCALE	DRAWN	CHECKED	MATERIAL & SPECIFICATION	TITLE
	GDH			PRINTER INTERFACE PCB
DIMS	DATE	AUTHORISED	FINISH	DRAWING No. / SHT / OF
	26-OCT-98			SC315586 / 1 / 1